

Design project 3



Rescue kit for floods

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Need

Life Rescue Survival





Rescue Vehicle for Floods

Need and Motivation



Need Objective

Saving lives

Solving the issues related to flood

Finding opportunity for the new product development



Research

Problems

How ?

Equipment's

System

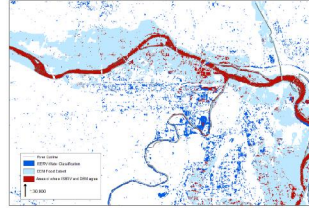
Activities





Research System

Flood estimation



Satellite Image study



Field observation

Flood Evacuation

Department centric planning

Making online Inventory

Planning: Staff competency,
Testing emergency operation

Coordination between
institutes at state, district and
national level

Flood Response

Central Level

>

District Level

State Level

Flood relief



Research Secondary

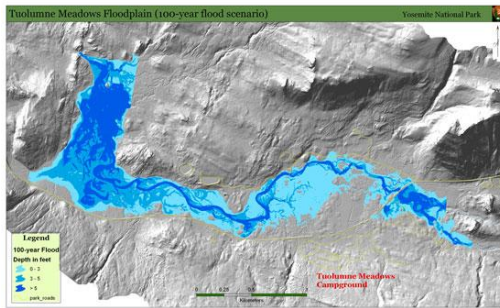
Pre flood functions

During flood
functions

Post flood
functions

- Planning Emergency Relief by State Gov.
- Emergency Response team alerted
- Pre positioning

1.ICS (Incident Command System):



GIS maps



Simulation model



Scenario analysis



Research Secondary

Pre flood functions

During flood
functions

Post flood
functions

- Planning emergency relief by state gov.
- Emergency response team alerted
- Pre positioning

2. Alerting Response and Support teams:



First Responders: Locals
(past 80% cases)



Secondary Responders:
NDRF, IA, IAF,BSF



NDRF Assistance:
ATIS, CD, Home guards, NGOs



Support Team:
NCC, NSS (National service
scheme)



Research Secondary

Pre flood functions

During flood
functions

Post flood
functions

- Planning Emergency Relief by State Gov.
- Emergency Response team alerted
- Pre positioning

3. Planning and Relief



Emergency shelters



Healthcare facilities



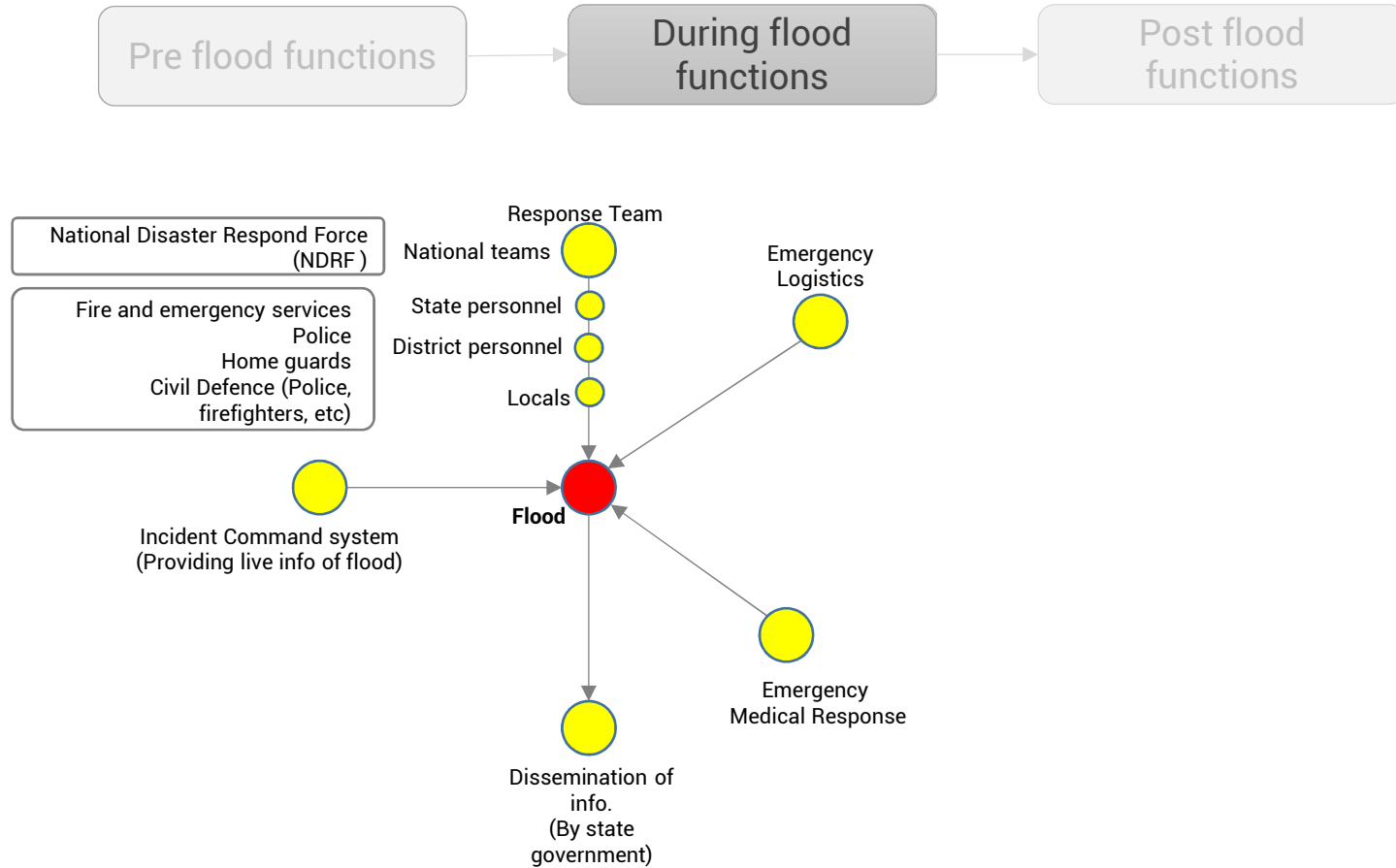
Water, food supply



Distributing Relief

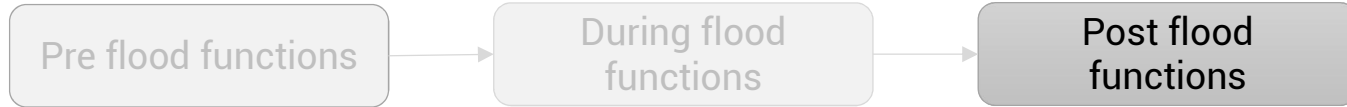


Research Secondary





Research Secondary



Relief Camp setup to provide shelter to those who fled their villages

Operations:

- Mobilisation of relief supplies
- Tents
- Water supply
- Sanitation system
- Communication support
- Medical support



Research Secondary

Flood affected area of Kashmir



- More than **400 deaths** overall in the Kashmir region ^[6]
- Over **600,000 people** remained **stranded** in Kashmir Valley



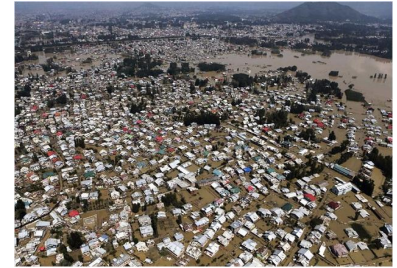
Research Secondary



Evacuation activity of women and the elderly from flood becomes difficult



difficulties in crossing river



Millions. Displaced, missing, starving



Jhelum river overflow



people got stuck because of high rise water



water overflows over bridges



Research Secondary



Rescue activity by belongings



Problems of rescuing from 1st floor when water level is till first floor



Rescue activity by NDRF personals



Death due to cold water and hyperthermia



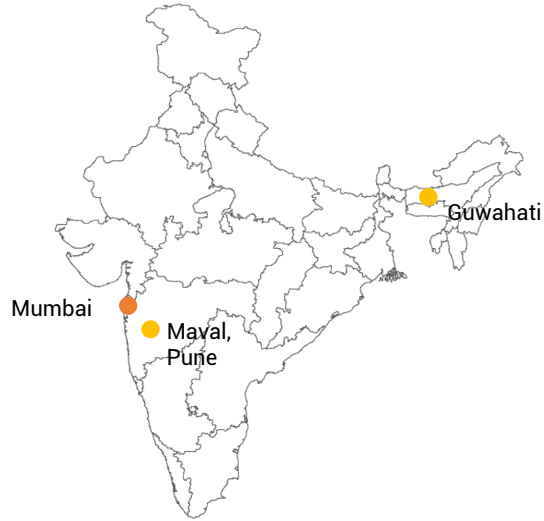
Dead bodies & animal carcasses are beginning to emerge



Airlifting in inaccessible areas



Research field visit



Locations visited (in order):

- 5th battalion, Talegaon (Maharashtra),
- 1st battalion, Azara, Guwahati (Assam)
- RRC (Regional Resource Centre) in Mumbai

Purpose:

1. Know how of operation procedure
2. Understanding equipment and usage
3. Identifying problem areas
4. Documentation

Methodology:

1. Photo Documentation of equipment
2. Interviews





Research field visit

- **Activities of NDRF personals**

1. Rescue
2. Relief
3. Rehabilitation



*Basic Training and
Specialised training*



Community awareness programme



Study of Typology and Geography



Familiarization exercise, Mock drills



Pre-disaster posting



Operations



Research field visit

High value equipment's used by NDRF Personals - Boats/ Rafts:



*Rubberised boat 25
to 75 HP OBM*



Inflatable rescue raft



*FRP boats (40 HP motor, carrying
capacity: 30 people, Need to be
transported in trucks)*

Life saving equipment's



Life buoys



*Life
Jackets*

Other equipment:



Diving Suit



ASKA light tower



*Portable oxygen
unit*



Research field visit

- **Improved Floating Devices**



Water bottle vest



Coconut shell vest



Matka and tin-can floating units



Basketball



Plastic pots



Plastic pots







Thermocol units



Research field visit

• Chart representation comparison of various flotation devices and boats

Factors	Rubber Raft (Circular)	Inflatable Boat (OBM)	FRP Boat	Banana boat	Improvised (Single person unit)	Bamboo Raft
image						
Structure	Tubular	Tubular + Al channels + Plywood	bowl type	Banana tree + wooden bed	Flexible + tied	Modular + tied
Types	Close	Open	Open	Open	Vest	Flat bed
Material(s)	Hypalon/neoprene, PVC or <u>Polyurethane</u>	Rubber coated Fabric, Nylon Reinforced Hypalon	FRP Boat	Banana tree	Coconut shell/ Pl. Bottle / tin - can	Bamboo
Auto deployment	Yes	Yes	No	No	No	No
Maintenance	Semi skilled	Skilled people	Skilled people	Semi skilled	Semi skilled	Semi skilled
Indication	Light on top + reflectors + orange color	Bright Colours	Bright Colours	None	None	None
Depth of water req. to float	1-2 feet	2-3 Ft	2-3 ft	0 - 1 feet	0 - 1 feet	0-1 feet
Capacity (People)	25 people	07-10 people 800kg	12 (1200KG)	Non standard	1	Non standard
Safety features	One way valve + multi compartments	1 way valve, provided with bow storage bag and safety kit	remote control steering	always floating	always floating	always floating
No. of people to drive	2 (pedaling)	1	1	1 (pedaling)	1 (pedaling)	1 (pedaling)
Weight	less tha 100 kg	Drt wt. 75 kg (w/o OBM)	350 kg (w/o OBM)	Non standard	less than 2 kg	Non standard
Size (lbh)	64"H x 25"L x 23"W	4200X1800X1000 19' tube dia	15ft X 6ft X 2.5ft	Non standard		Non standard
Cost	4.5 lacs	3.14 lacs	4.11 lacs			
Packaging	Foldable	Foldable	non foldable	Non folddable	Foldable	Non folddable
Transportation	By air/ trucks	Truck	Truck	Manual lifting/ trucks/ air	Manual lifting	Manual lifting
Power source	Human powered	Motor - 25HP	motor - 40HP	Human powered	Human powered	Human powered



Design Brief





Design Brief – Direction

Design Directions

Problems and Issues which are critical

1. Being Prepared for the situation
2. Quantity of the safety equipment's
3. Safety in water (flow, depth, snakebites)
4. Direction (navigation) and search for the safe place
5. Provision of water, food and medicine
6. Safety of belongings



Design Brief – Direction

"To Design a victim centric, portable, self rescue kit for an individual, in urban flood scenario which will allow person to float, move in still water and also will protect from flash floods"

Basic specification

Capacity - 1 person (120 kg max)

Users male/female

weight – should less than 5 kg

Min life span- approx. 5 years

Critical

Floating

Prevention from toppling

Protection from debris

Easy to use even by the illiterate

Prevention from drifting away

Important

Portable

protection from rain

Quickly deployable within 1 min

Keeping person dry

Indication to the rescuers

Desirable

Reusable

Navigation aid

Night rescue assistance

Owned by the people



Design Brief – Direction

Rescue from home



Broken glass on wall



Barbed wire



Wall railings

Navigation



Fast flowing water



Whirlpool



Open Manholes

Dangers



Parked cars



Electricity wire



Snake



Debris



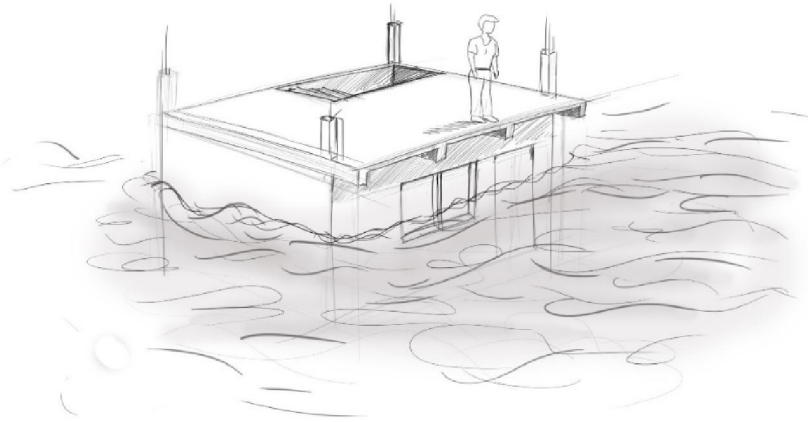
Design Brief – Direction



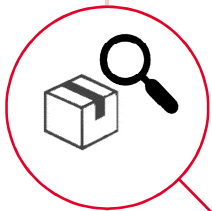
Situation 1 : rescue possible only through window



Situation 3 : when water starts rushing into the house



Situation 2 : rescue possible from roof top



Design
materials
Structure
detailing

Product study





Product study – flotation devices

EVA foam floats



A standard EVA foam kickboard

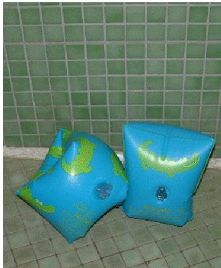


Waist belt



Foam Grip Pull Buoy

Air filled floats



arm bands



Ring buoy



air filled life jacket



Kerala's traditional circular boat - Coracle



Indian Small Boat



Product study – flotation devices

Amusement Park floating devices



Swimming Pool Chairs



inflatable pool float



buoyant pad



Swimming Pool Chairs



Product study – flotation devices

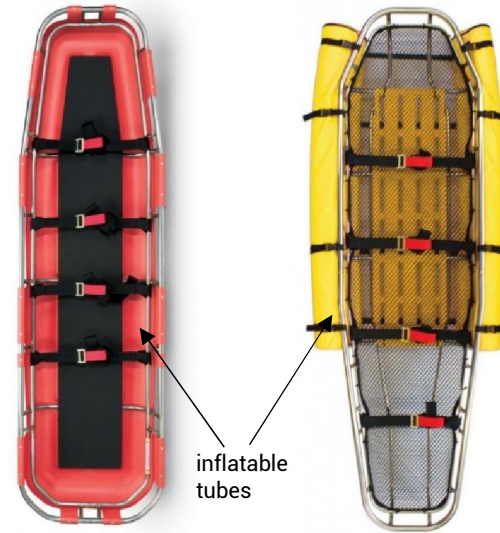
Stretchers

for patient transfer from water

The tubular structure is used to increase the strength and foam floats or inflatables are used to keep stretcher floating.



Stretcher with foam material for buoyancy



Stretcher with inflatable tubes



Product study – Material

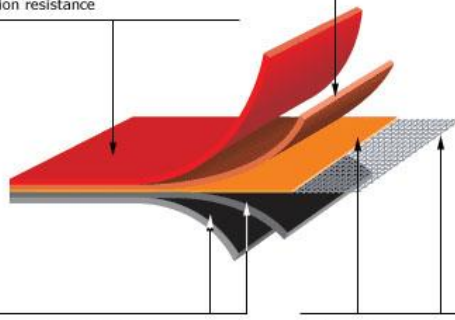


rubberised inflatable boat

Outside CSM layer gives:

- > weather resistance -fading and ageing)
- > chemical resistance
- > abrasion resistance

Layer of Neoprene in between the CSM and the textile.



Inside Neoprene sheets give:

- > high gluability and reliable adhesion
- > air tightness (no air in the high textile)

High Tenacity Textile gives:

- > basic mechanical properties (tensile and tear strenghts)
- > dimensional stability

PVC COATED FABRIC:

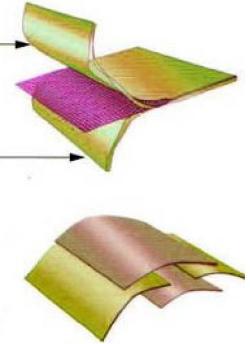
0.9mm, 1100 Denier polyester fabric which has been specially coated on both sides with PVC.

Features:

- Outside PVC layer offers:
Abrasion resistance;
Extreme condition resistance;
Chemical resistance.
- Inside high polyester fabric offers:
Dimensional stability;
Tensile and tear strength.

Points of making

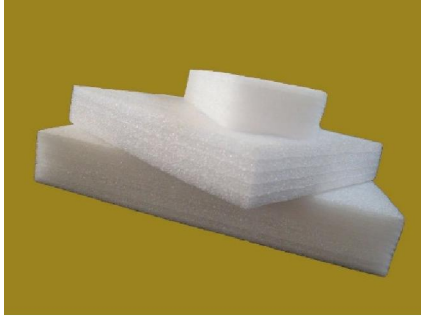
- Adhesive structure
- Polyurethane glue
- Cold welding
- Made by hand
- Four layers reinforced seams.



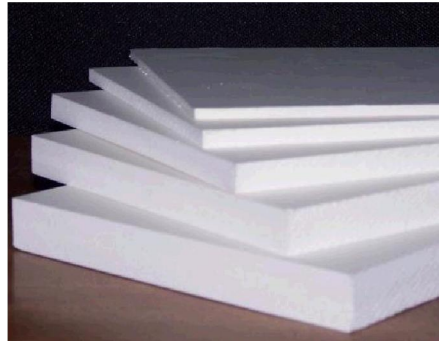
kickboards



Product study – Material



EPE foam in different shapes



Thermocol

EPE Foam (expanded polyethylene)

- Waterproof
- buoyancy: up to 50 times lighter than water
- inert: resists to organic solvents and numerous chemicals
- non toxic
- easy to cut by hot wiring or sawing
- complex shaping using moulds

EPS (Expanded Polystyrene) thermocol

- lightweight material which floats (density 150-400 kg/m³)
- excellent mass to volume ratio
- excellent thermal and acoustic insulation
- excellent mechanical properties (strength, damping)
- waterproof and mold resistant
- non-toxic (no CFCs)
- versatile and easy to shape
- best price/performance ratio than most construction materials



Product study – Life jackets



Inflatable Life jacket before and after inflation



CO2 Cylinders used in life jacket for inflation



valve arrangement for CO2 cylinder



Off-shore Life Jacket

- 22 pounds of buoyancy.
- Inflatable and Inherently buoyant types.
- Used for Open, rough, or remote water, where rescue may be slow in coming.



Near-shore Buoyant Vest

- 15.5 pounds of buoyancy.
- Inflatable and Inherently buoyant types.
- Good for calm, inland water, or where you have a good chance of a fast rescue.



Ideations

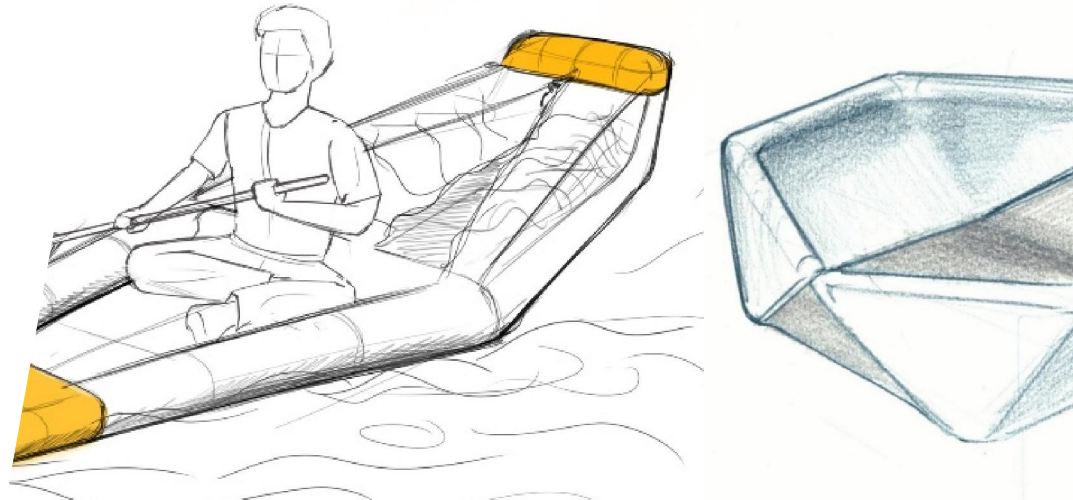
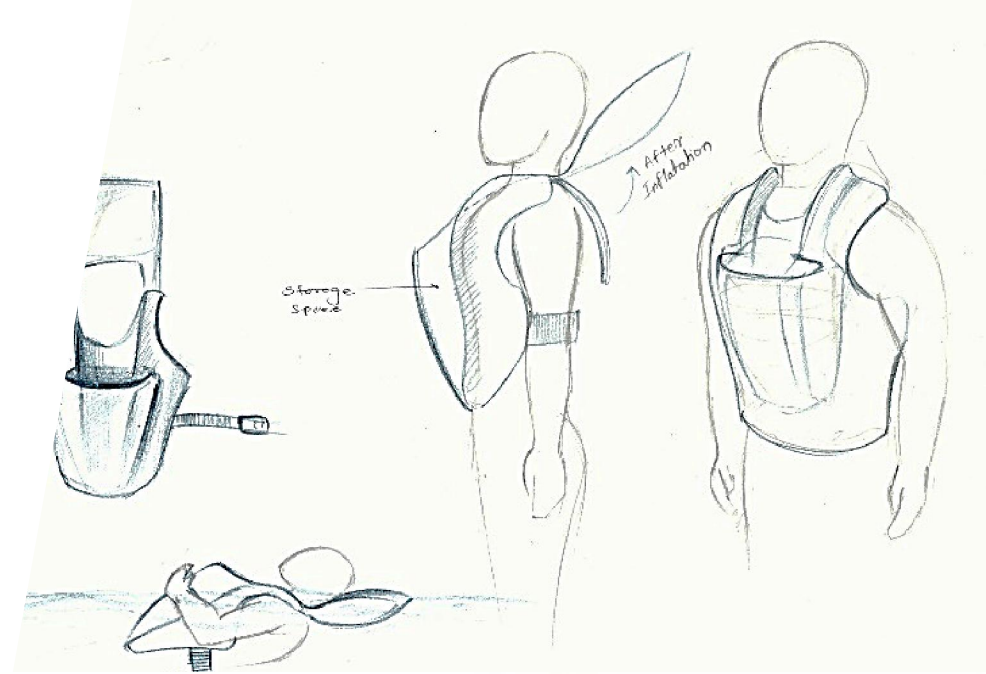
Mock-ups

Doodles

Concepts

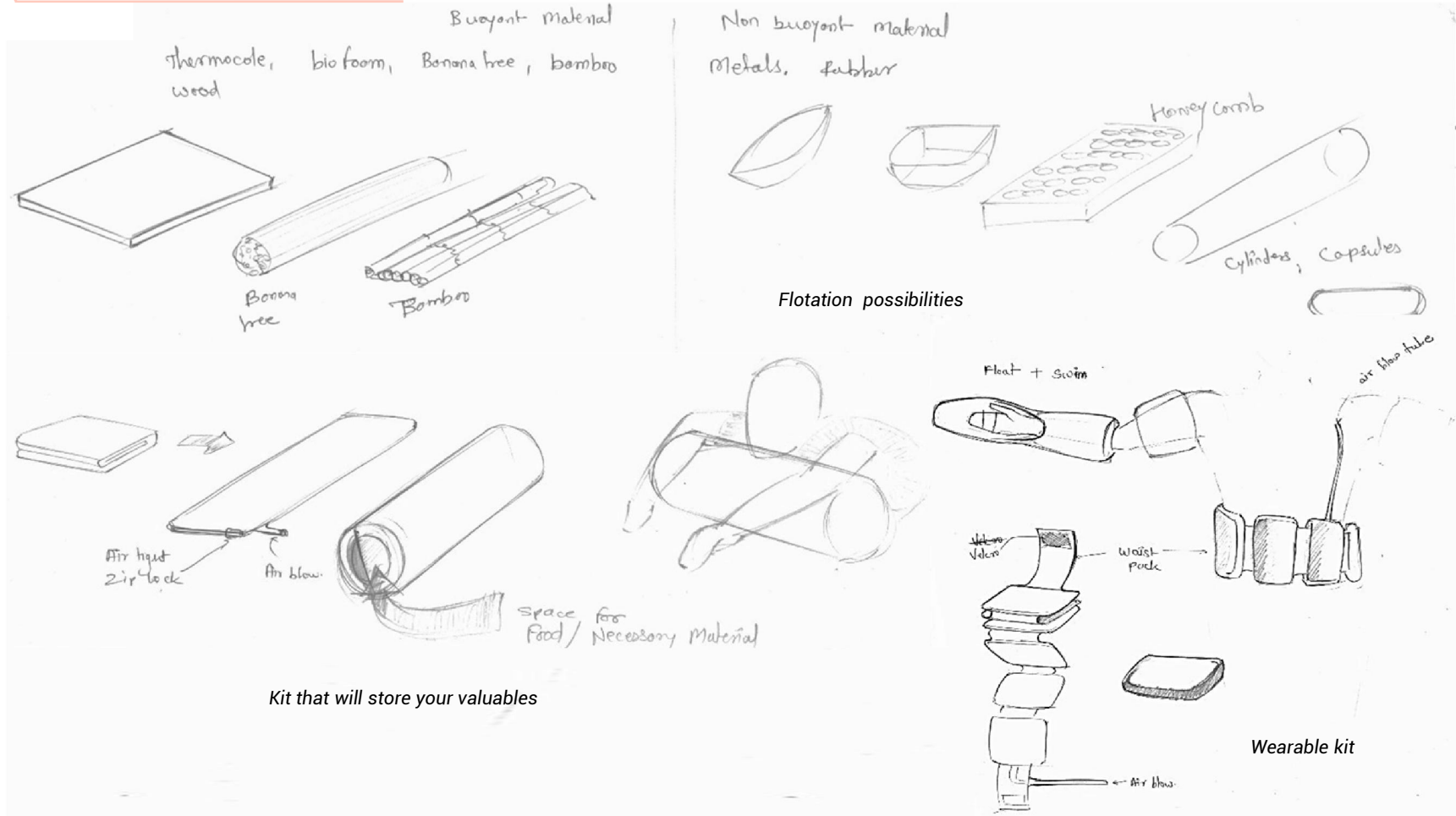
Illustrations

Concept



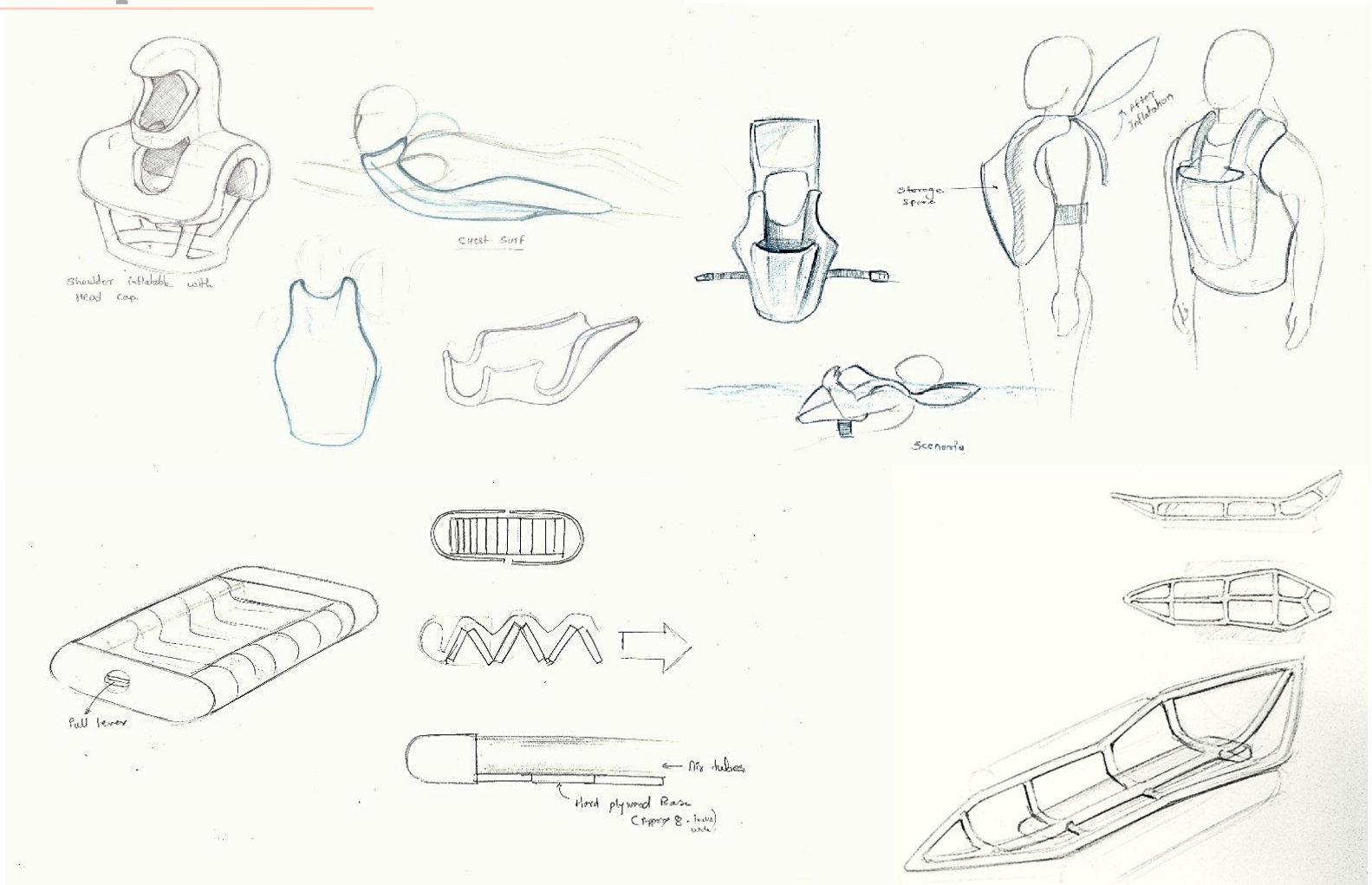


Concept – Doodles



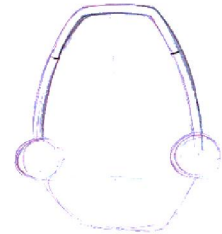
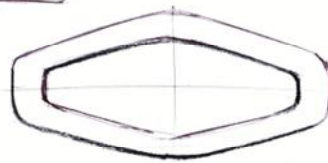
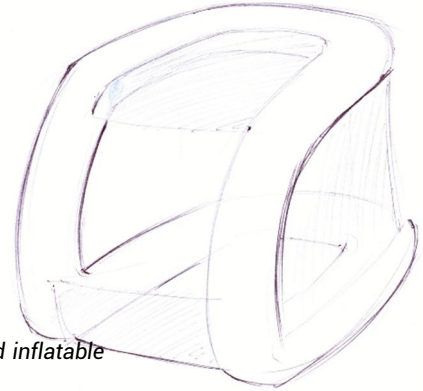
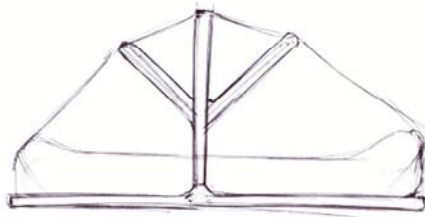
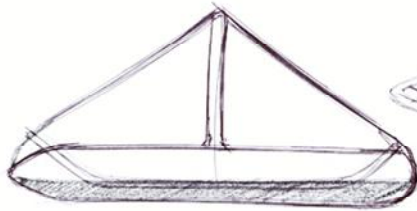
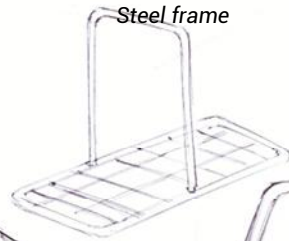
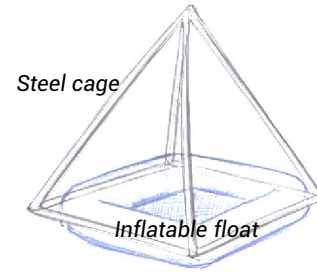
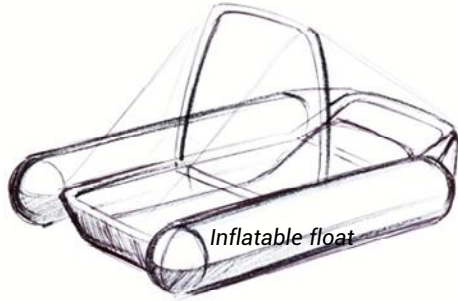


Concept – Doodles



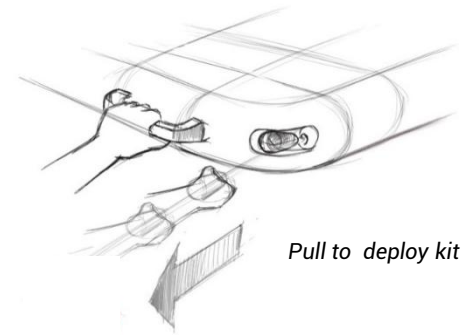
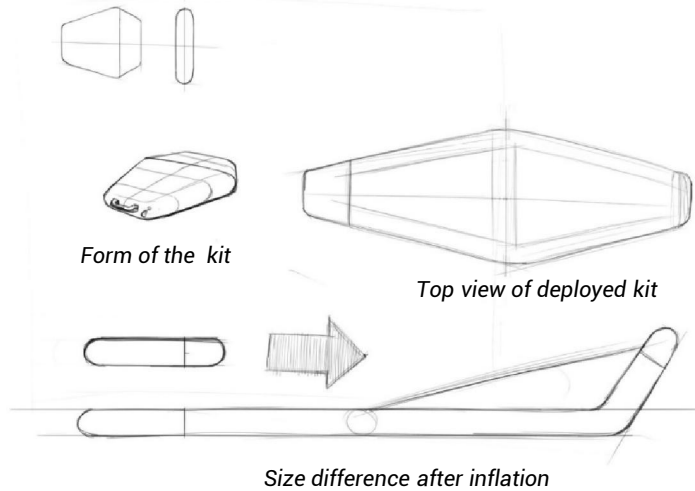


Concept – Doodles





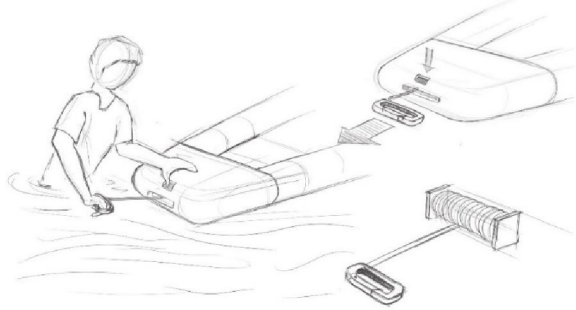
Concept – Foldable roof





Concept – Foldable roof

Activity



Hook arrangement for anchoring



Both directional mobility

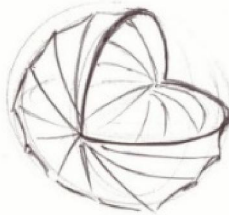
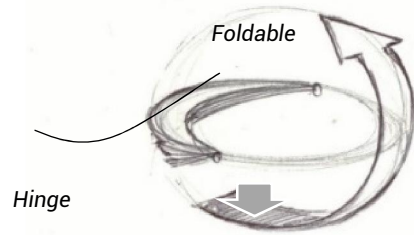


Foldable rain cover



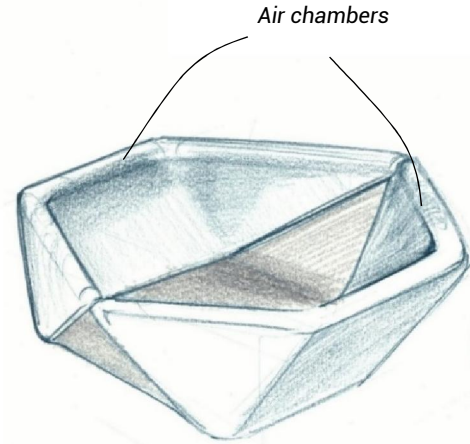
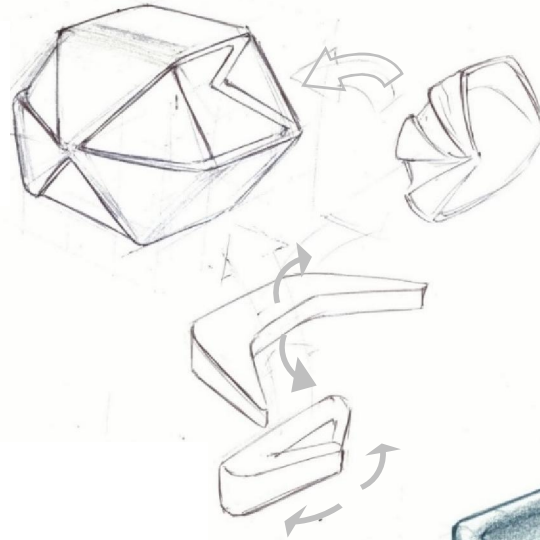


Concept – Hexagonal inflatable floating device



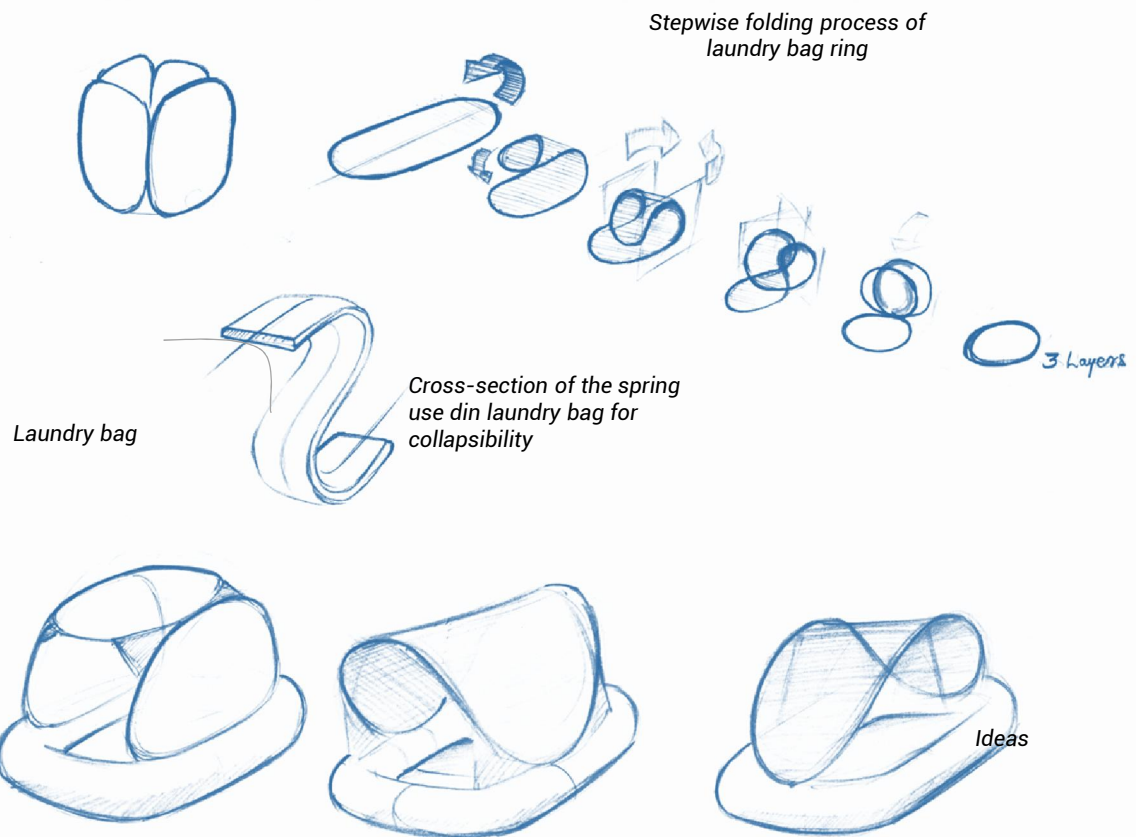
Air
Bellows.

Air chambers



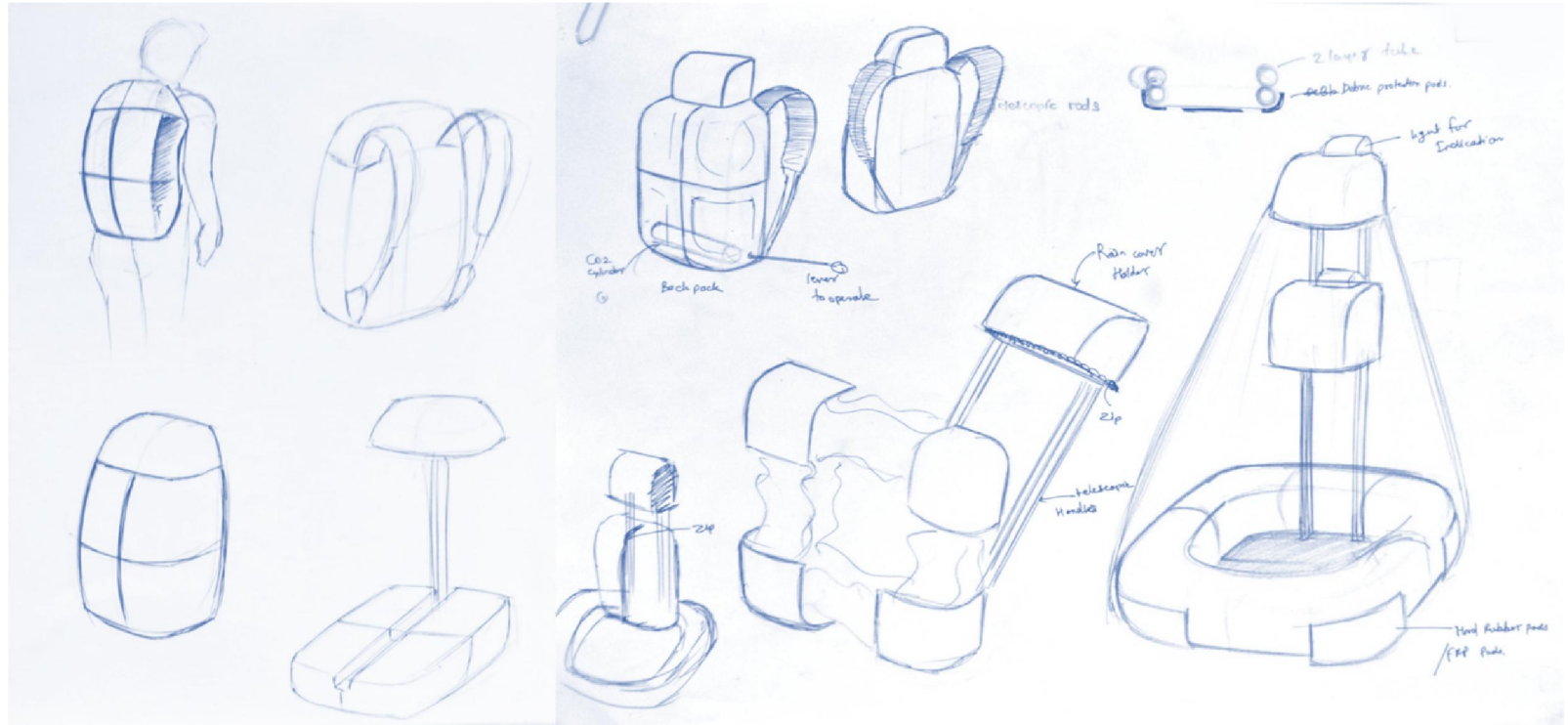


Concept – Hexagonal inflatable floating device





Concept – Backpack folding device

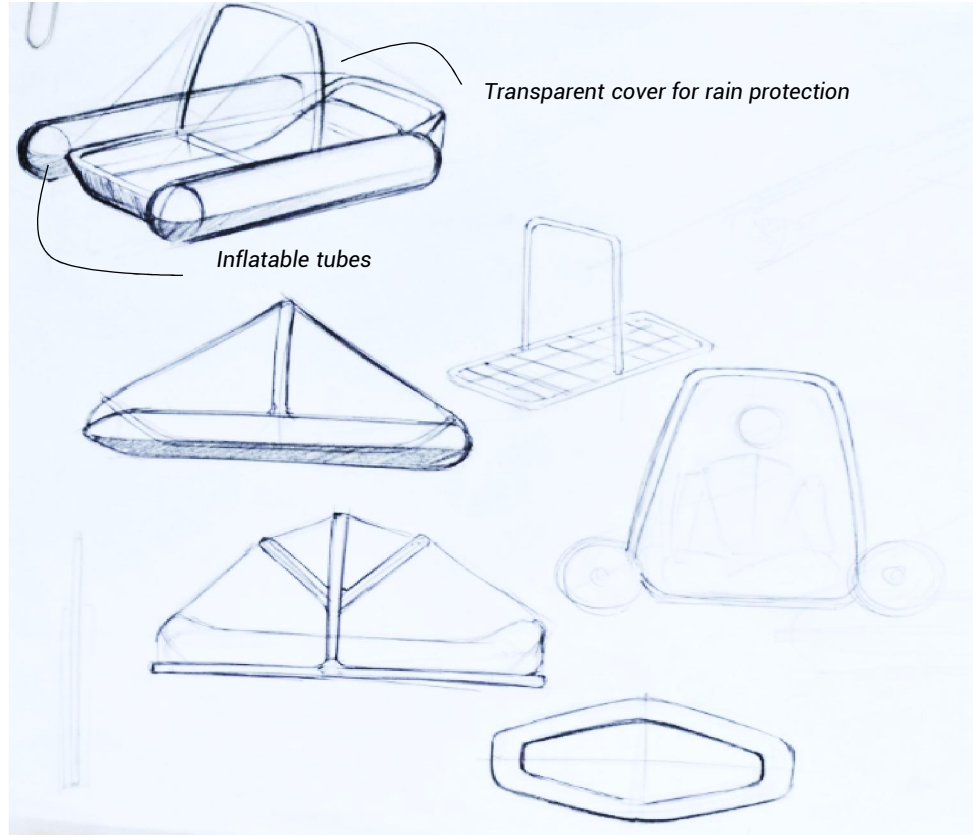




Concept – Inflatable with tubular frame

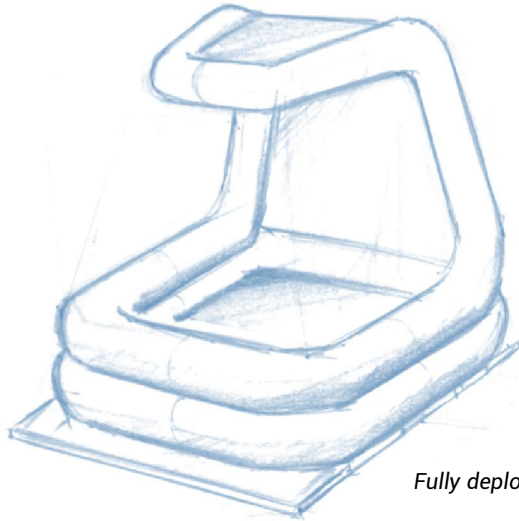


Inflatable tabular tent





Concept – Inflatable roof concept

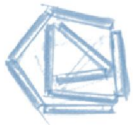


Fully deployed kit

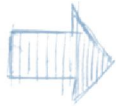


Top view

Inflation process of float



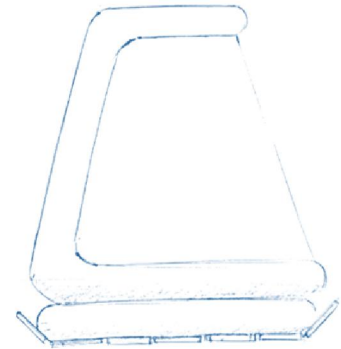
Wooden planks in rolled form



Unrolling of wooden planks



Inflation of rubber tubes

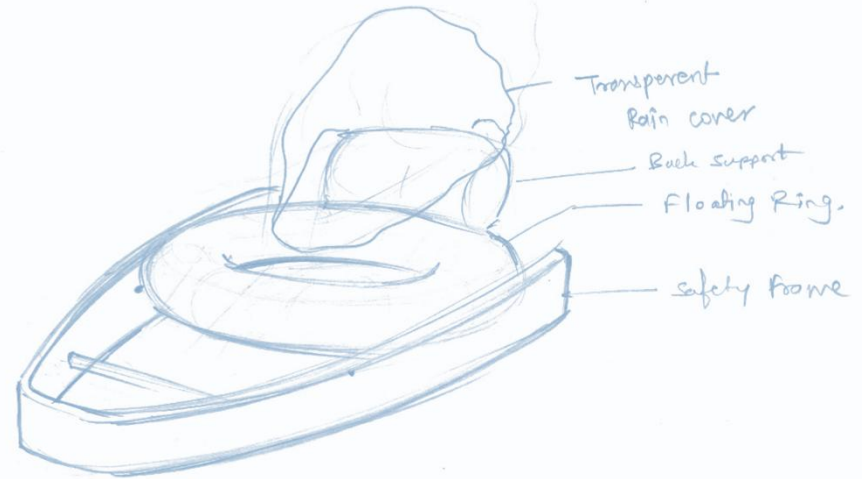
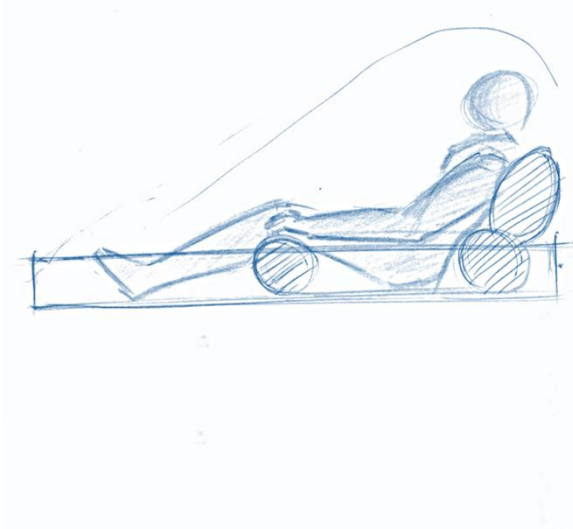
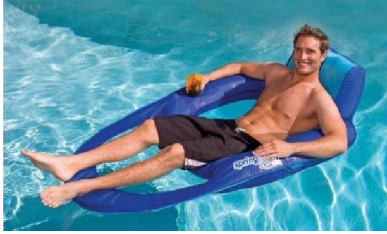


Inflatable tubes



Concept – Inflatable with rigid frame

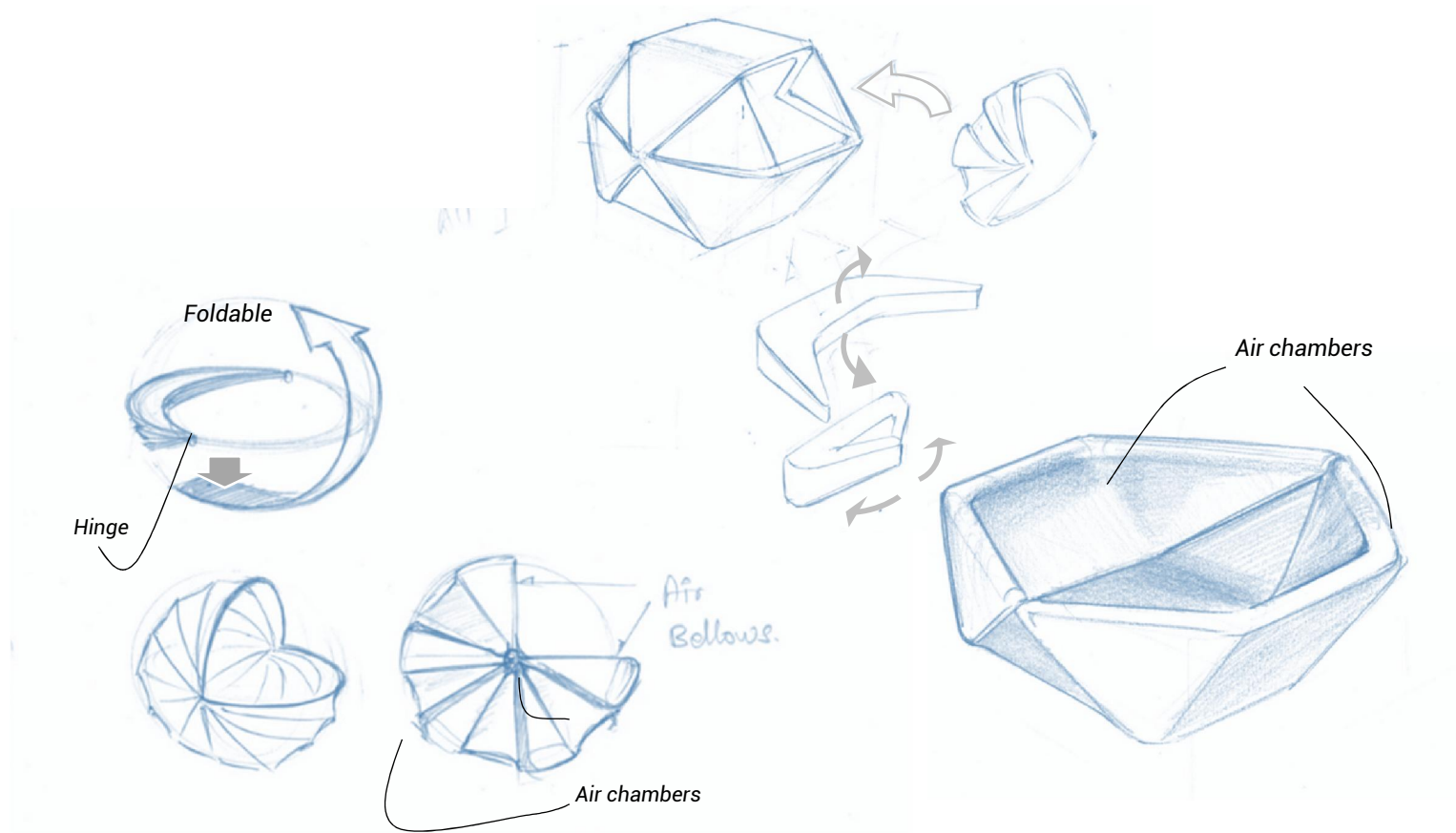
Inspiration : swimming pool hair headphones





Concept – Concept 1

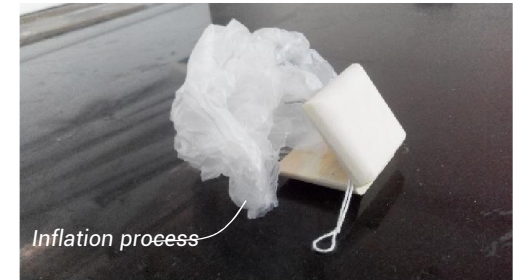
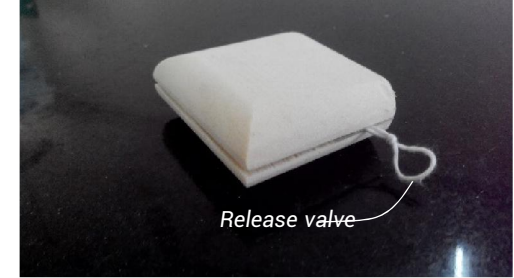
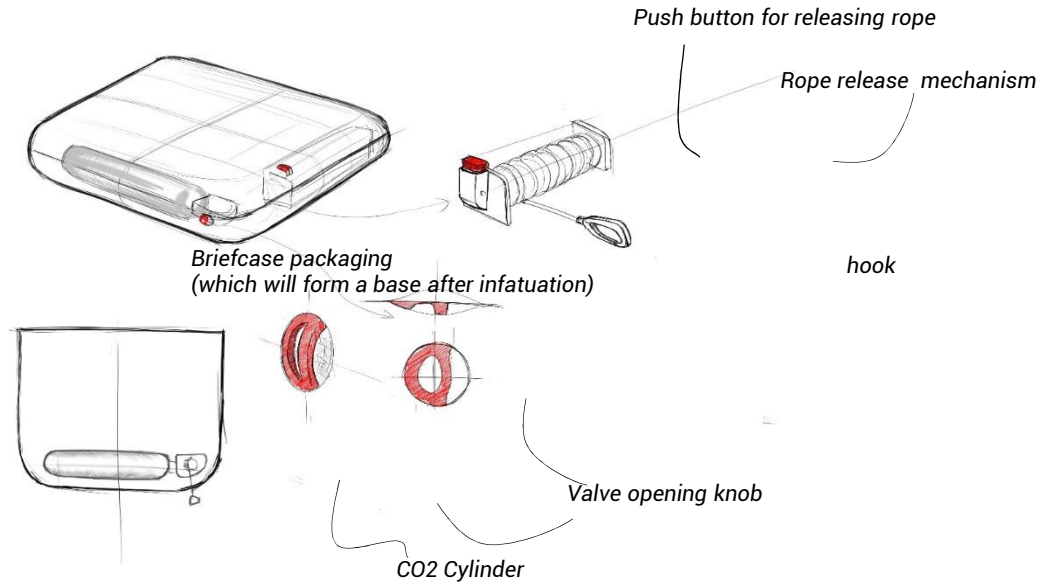
Hexagonal inflatable





Concept – Concept 1

Hexagonal inflatable





Concept – Concept 1

Hexagonal inflatable

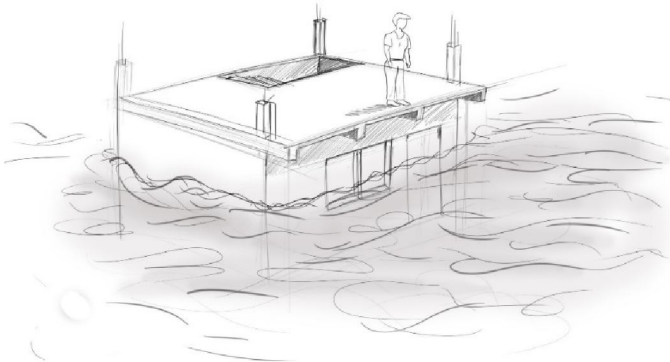


Situation 1 : rescue possible only through window

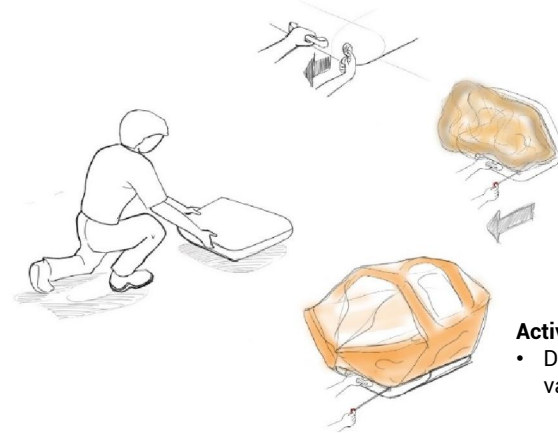


Activity:

- Tie kit rope to the strong structural member
- Deploy kit outside the house when water level is near to the window sill



Situation 2 : rescue possible from roof top



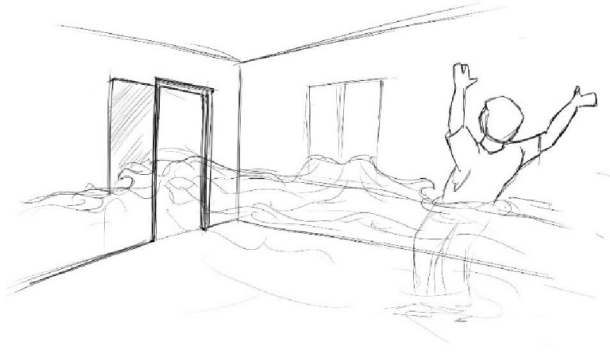
Activity:

- Deploy kit by pulling valve knob

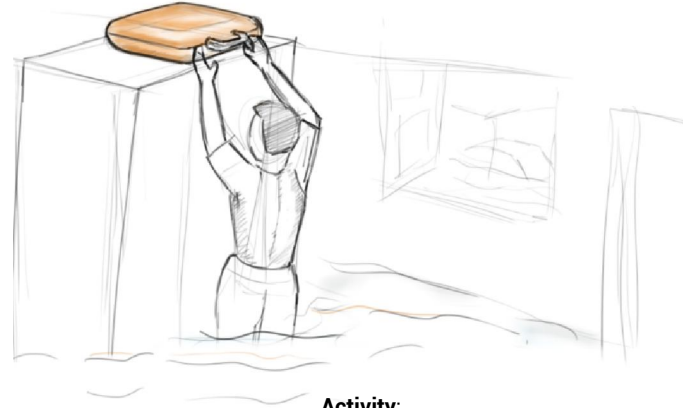


Concept – Concept 1

Hexagonal inflatable



Situation 3 : when water starts rushing into the house



Activity:

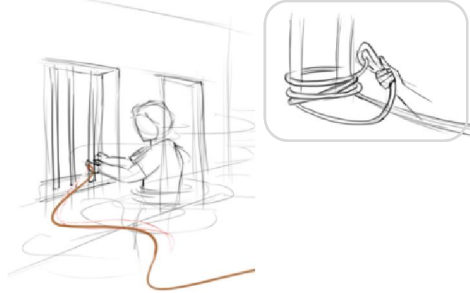
- Deploy the kit outside the house as soon as possible



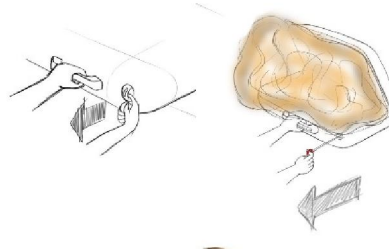
Concept – Concept 1

Hexagonal inflatable

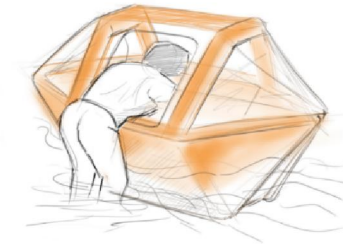
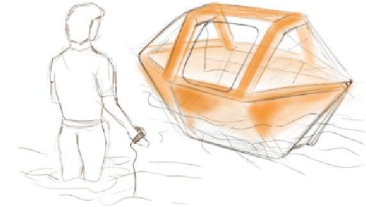
- 1 Tie rope of the kit to the safe place with the help of hook



- 2 Release the knob by pulling it



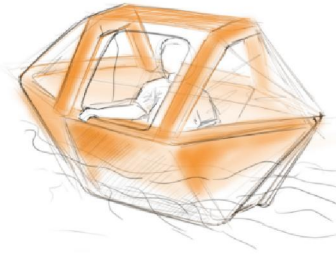
- 3 Pull out the kit with rope



- 4 Slide in to the kit



- 5 Turn around to get in



- 6 Zip on to close rain protection cover



- 7 Mobility with the help of pedals

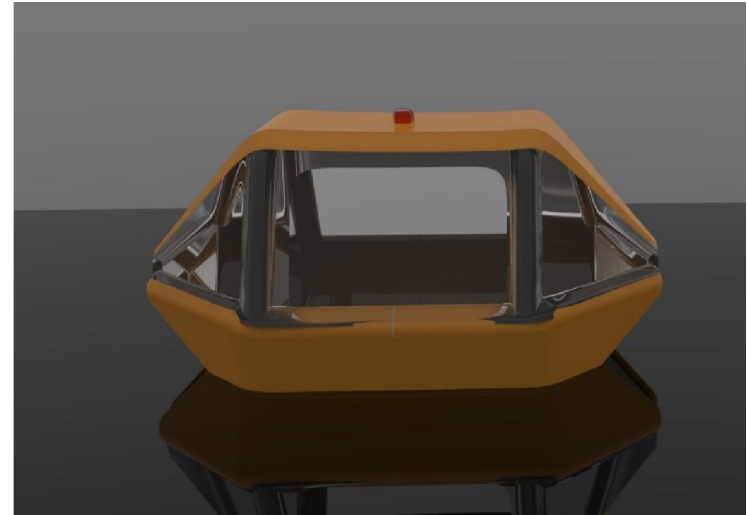
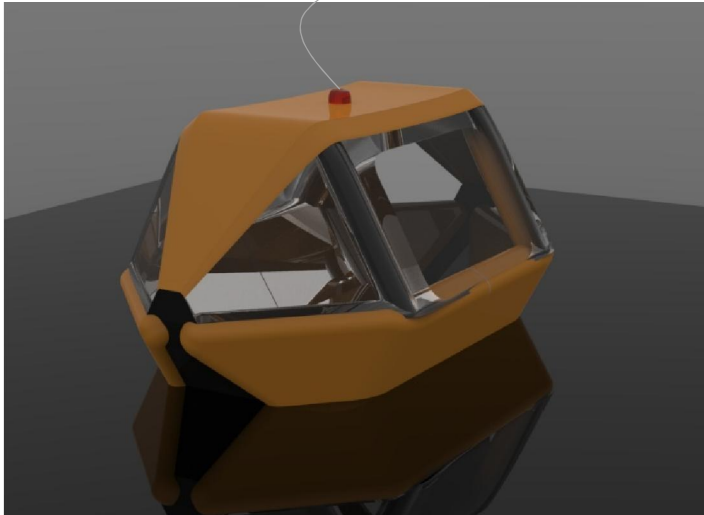
- Illustration of activity of deployment of kit



Concept – Concept 1

Hexagonal inflatable

Light for indication to NDRF

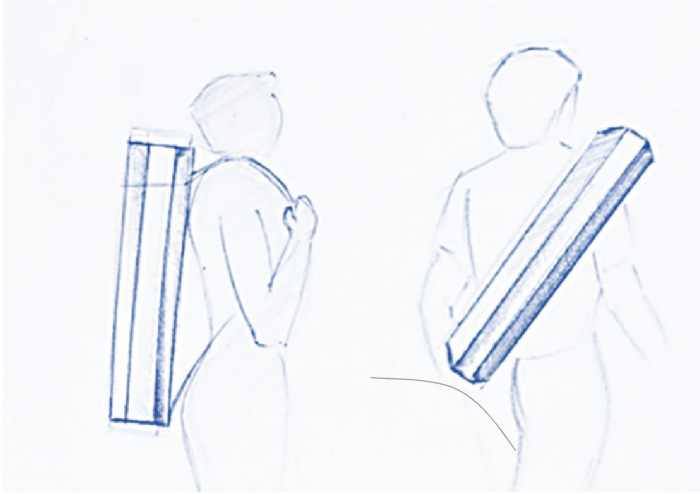


- Digital model

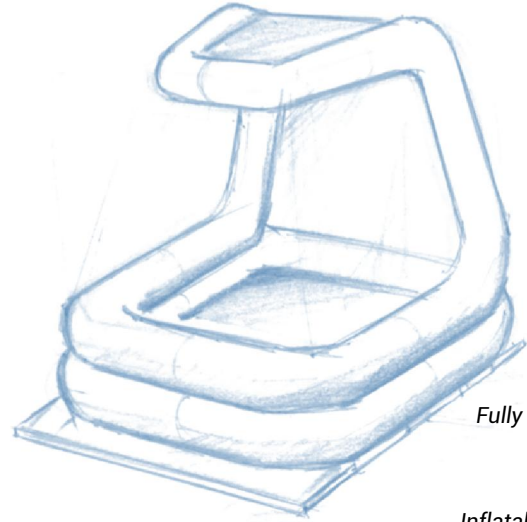


Concept – Concept 2

Inflatable with wooden base

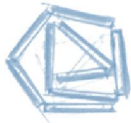


Kit in folded form

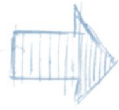


Fully deployed kit

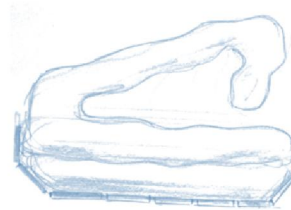
Infatuation process of float



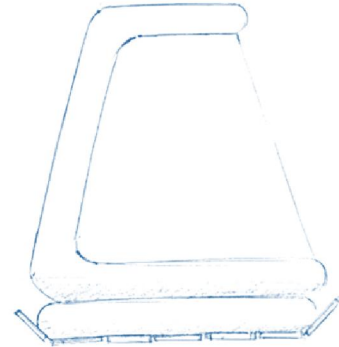
Wooden planks in rolled form



Unrolling of wooden planks



Inflation of rubber tubes

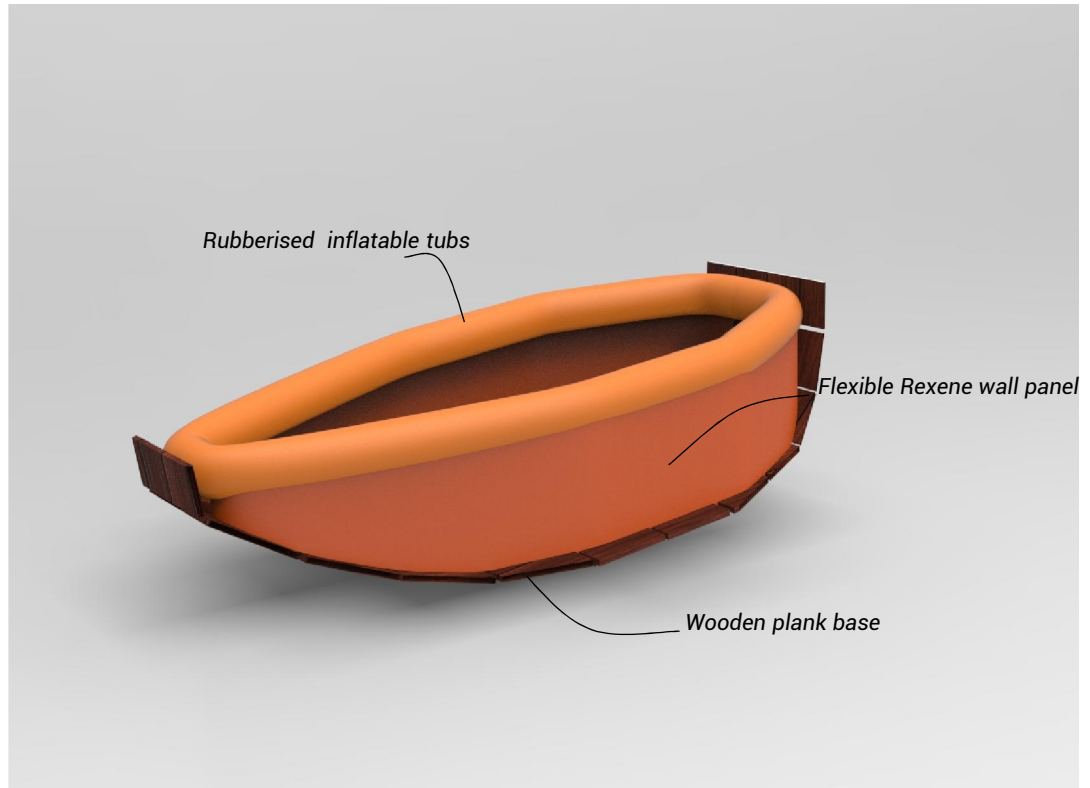


Inflatable tubes



Concept – Concept 2

Inflatable with wooden base



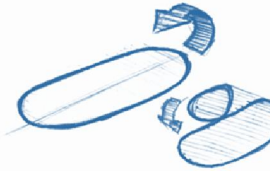
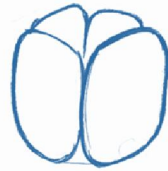


Concept – Concept 3

Collapsible



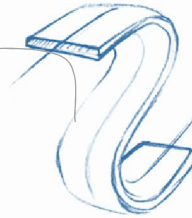
Laundry bag



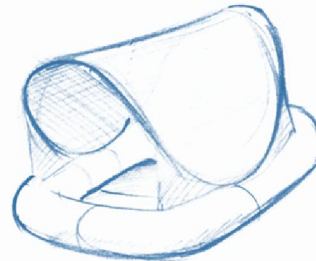
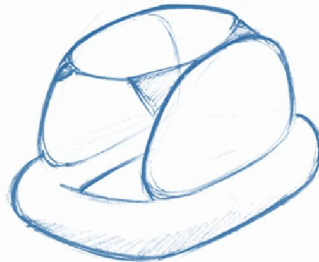
Stepwise folding
process of laundry bag
ring



3 Layers



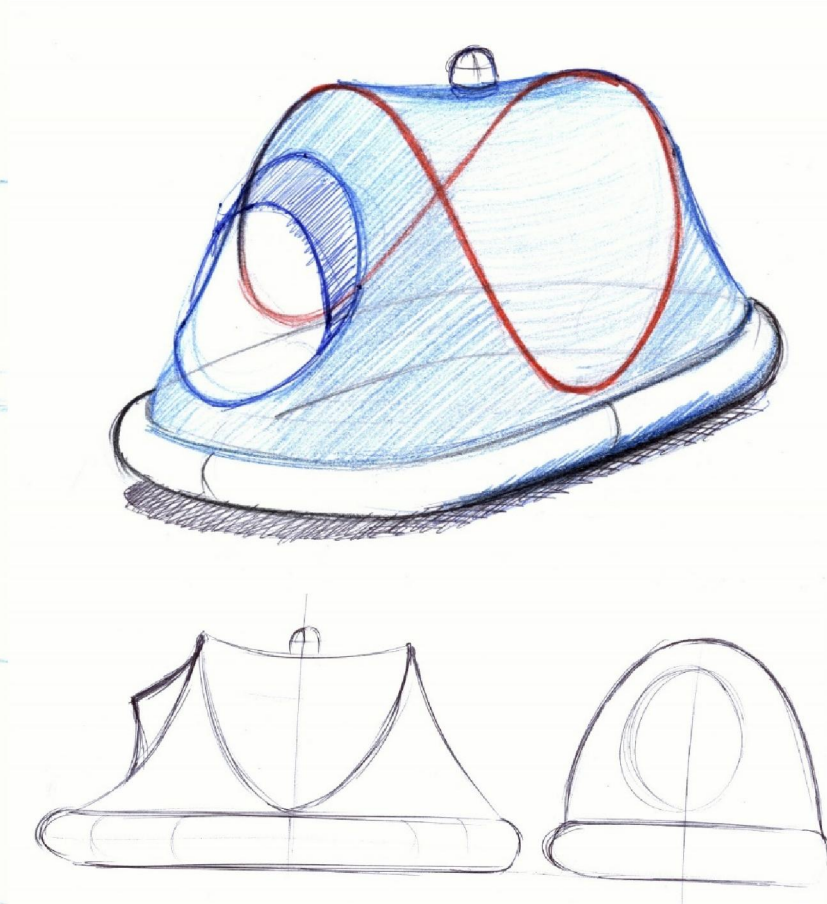
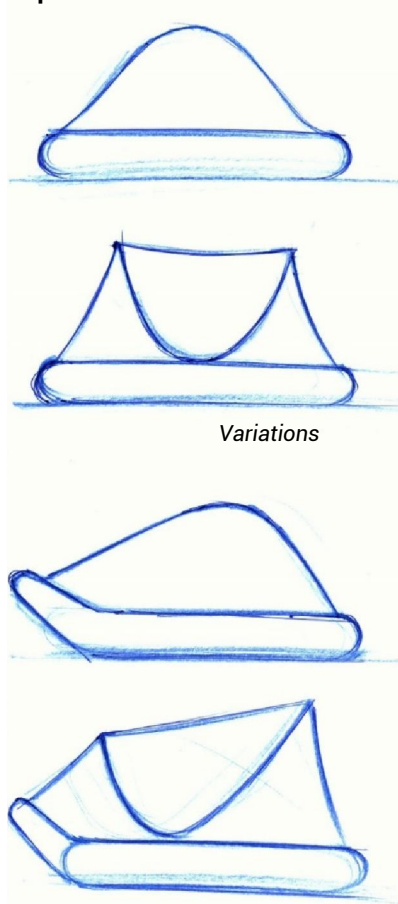
Cross-section of the
spring use din laundry
bag for collapsibility





Concept – Concept 3

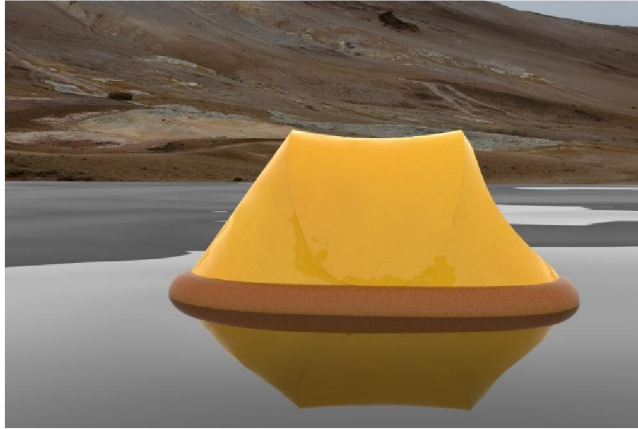
Collapsible





Concept – Concept 3

Collapsible



Digital models



Physical mock-up model



Concept – Feedback NDRF, pune



NDRF Personals attending presentation

Issues to be addressed critically

1. Toppling of kit during ingress and egress
2. Strength of the anchoring rope
3. Cost of the product should be minimum
4. Protection from debris and harmful objects in water is essential.
5. Demonstration and activity or stepwise procedure need to be explained.
6. Building confidence and trust is important.

Suggestions

1. Installation of a sensor which will activate when the kit is deployed
2. Night rescue possibilities
3. Manual pump for inflation
4. Hard base will be a better idea for debris protection



Concept – Feedback NDRF, pune

- **Insights**

1. People in Assam prepare themselves for flood (by learning swimming, making Improvised Flotation Device's).
2. They also experiments with different floatation devices at their own. There is a definite need.
3. Life jacket is not very helpful in flood situations.
4. Elderly must have dry kit.
5. Majorly it will help elderly a lot who don't know how to swim.

- **Good points**

1. Its an very innovative concepts
2. It will give relief to use also
3. People in Assam makes improvised floatation devise at their home. They will definitely use such kind if kits
4. Will be very helpful in scenarios like Kashmir
5. Idea of whistle and Overhead light is very good to identify



Concept – Feedback stage 3

- Ingress and egress into the kit when it is deployed is very difficult.
- Stability won't be there in flood water.
- There are no constraints in the design brief in terms, it's open ended.
- Jumping into the kit will not be possible
- **Suggestions:**
 - Make it wearable and attached to the body while getting into the water.
 - Focus primarily on keeping persona alive.



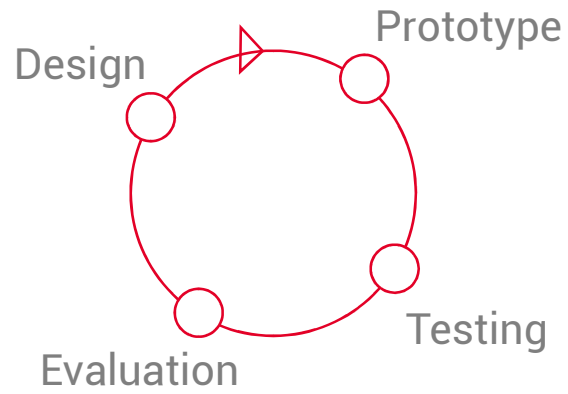
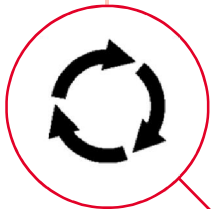
Concept – redefined design brief

Objective

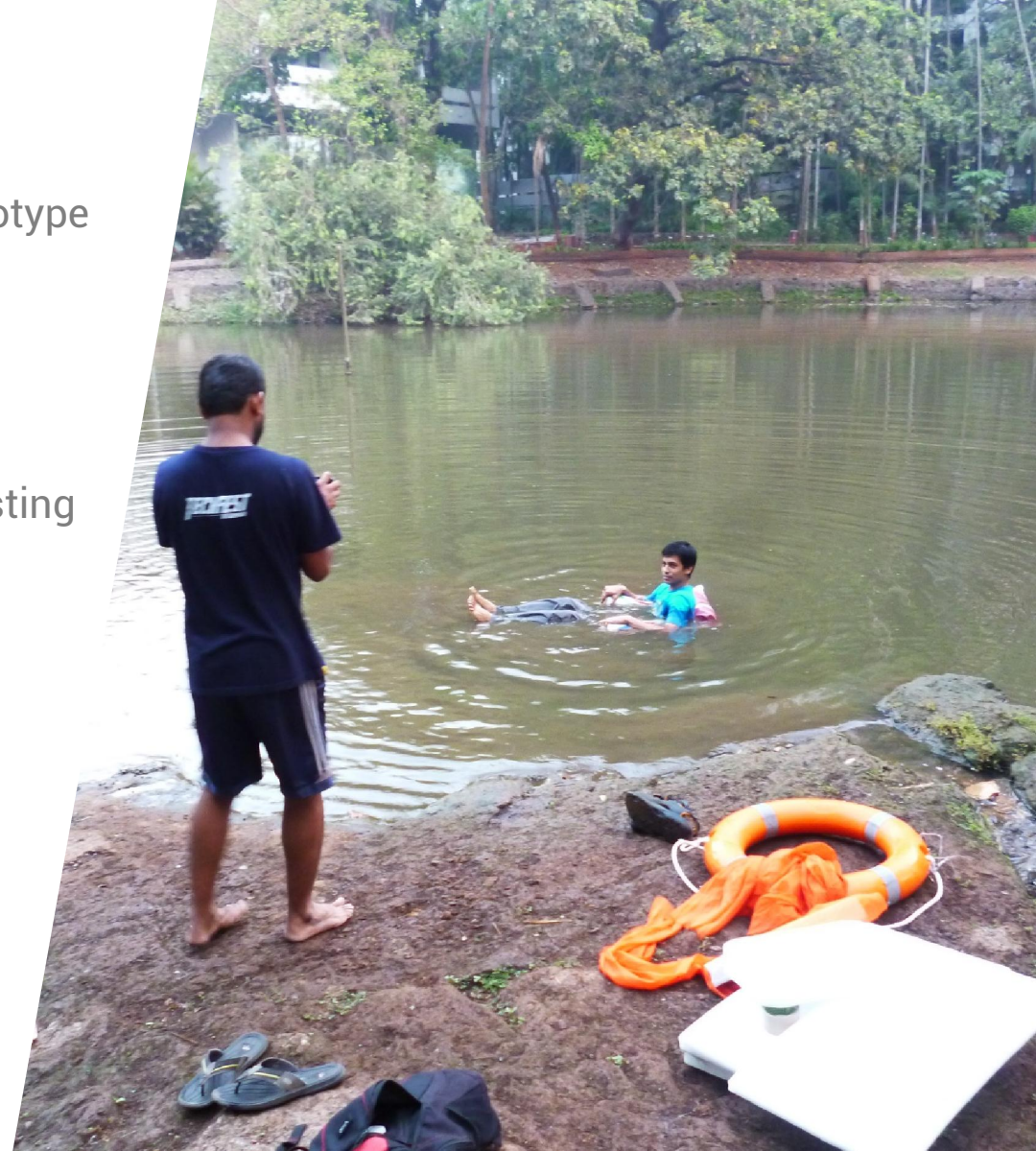
Design of a victim centric **self rescue kit** for an individual in urban flood scenario

Key points :

- Rescue a person and keep him alive
- Individual floatation device (Non motorised or propelled)
- Wearable and portable (foldable)
- Mass producible rescue kit
- Price within (approx. 1000-1200 Rs)
- Features:
 - *Rain Cover*
 - *Deployment within 30 sec*
 - *Lightweight (less than 5 kg)*
 - *Indication to the rescuers*
 - *Size – approx. length of 1 person*
 - *Prevention from drifting away – provision of rope with hook*
 - *Protection from debris*



Iterations





Iteration - 1st



Design



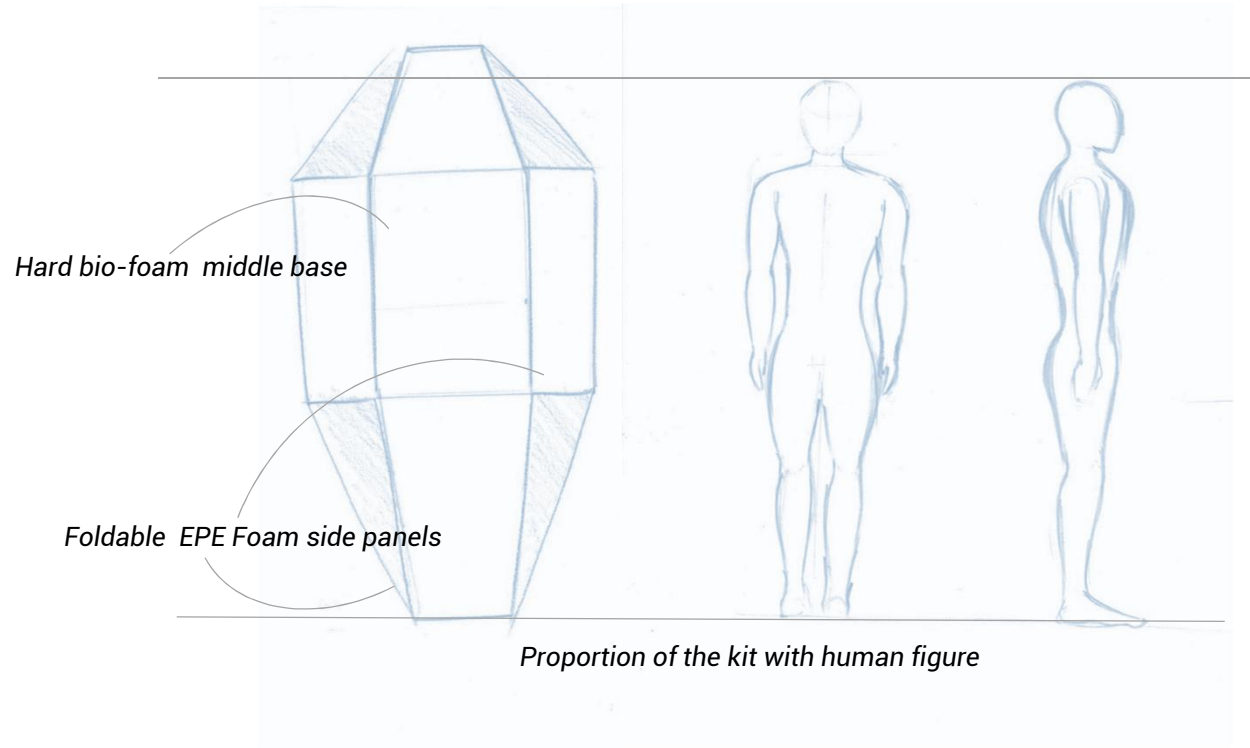
Prototype



Testing



Evaluation



Testing of -

Flotation
Seating posture
Toppling



Iteration - 1st



Design



Prototype



Testing



Evaluation





Iteration - 1st



Design



Prototype



Testing



Evaluation





Iteration - 1st



Design



Prototype



Testing



Evaluation





Iteration - 1st



Design



Prototype



Testing



Evaluation



Seating Position



Leaning Backward Position

Pros:

Stable in leaning position
It can take shape of body

Cons:

More buoyancy required
Ingress and egress is difficult



Iteration – 2nd



Design



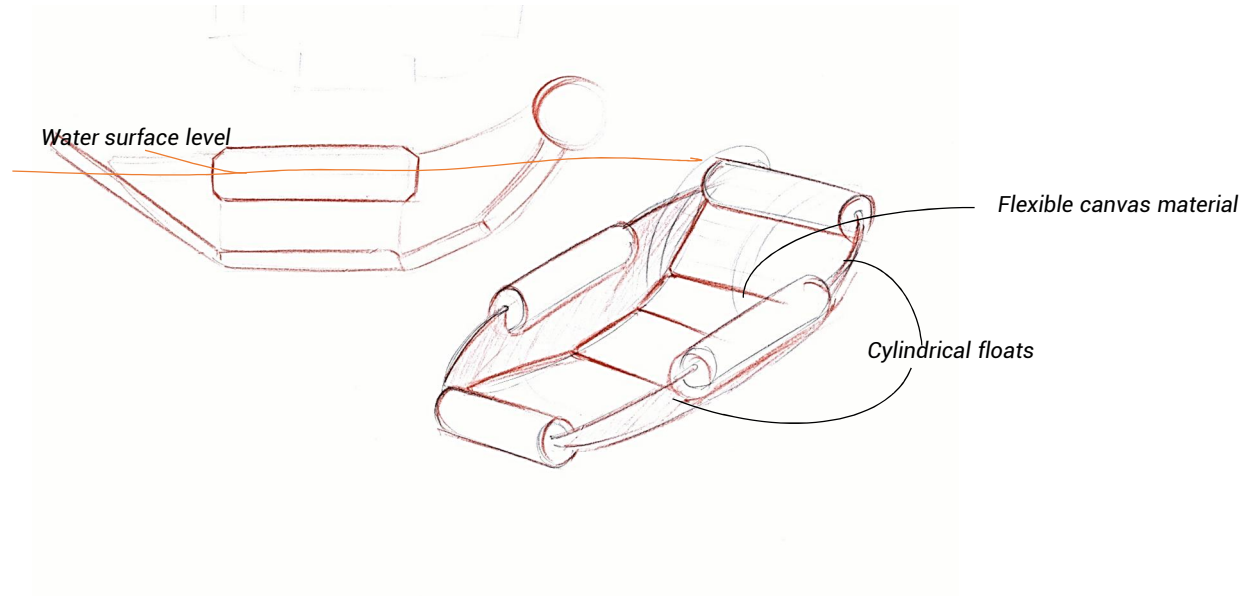
Prototype



Testing



Evaluation





Iteration – 2nd



Design



Prototype



Testing



Evaluation





Iteration – 2nd



Design



Prototype



Testing



Evaluation





Iteration – 2nd



Design



Prototype



Testing



Evaluation



Pros:
Possibility of multiple positions
- Straight, recumbent
Stable due to low C.G.

Cons:
Neck support is required
Waterproofing
leg support



Iteration – 3rd



Design



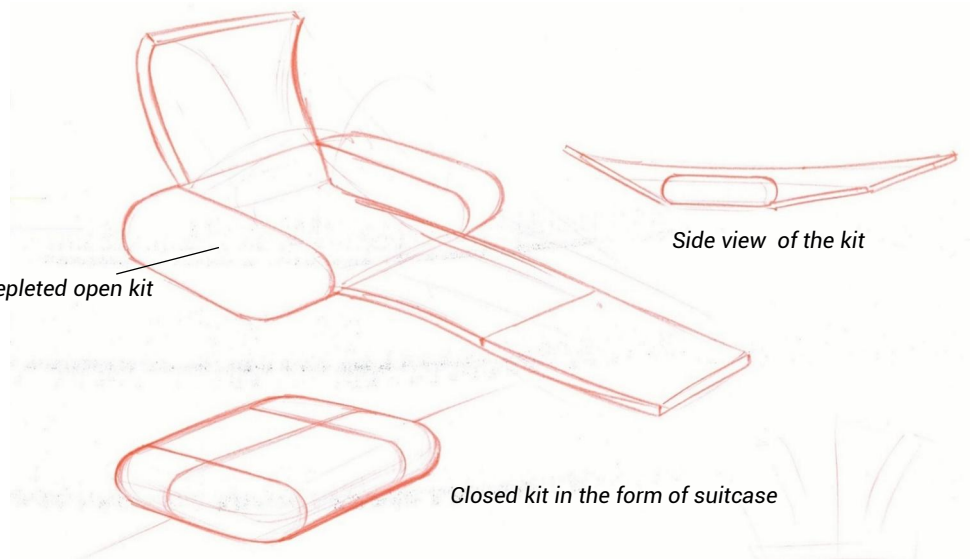
Prototype



Testing



Evaluation





Iteration - 3rd



Design



Prototype



Testing



Evaluation





Iteration - 3rd



Design



Prototype



Testing



Evaluation





Iteration - 3rd



Design



Prototype



Testing



Evaluation





Iteration - 3rd



Design



Prototype



Testing



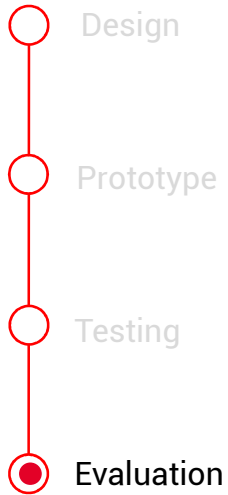
Evaluation



Testing of prototype in water



Iteration - 3rd



Pros:

Possibility of multiple positions
- Straight, recumbent
Balancing is good

Cons:

Short length of floats are less effective in toppling
Waterproofing
No head protection
Legs are constrained



Iteration - 4th



Design



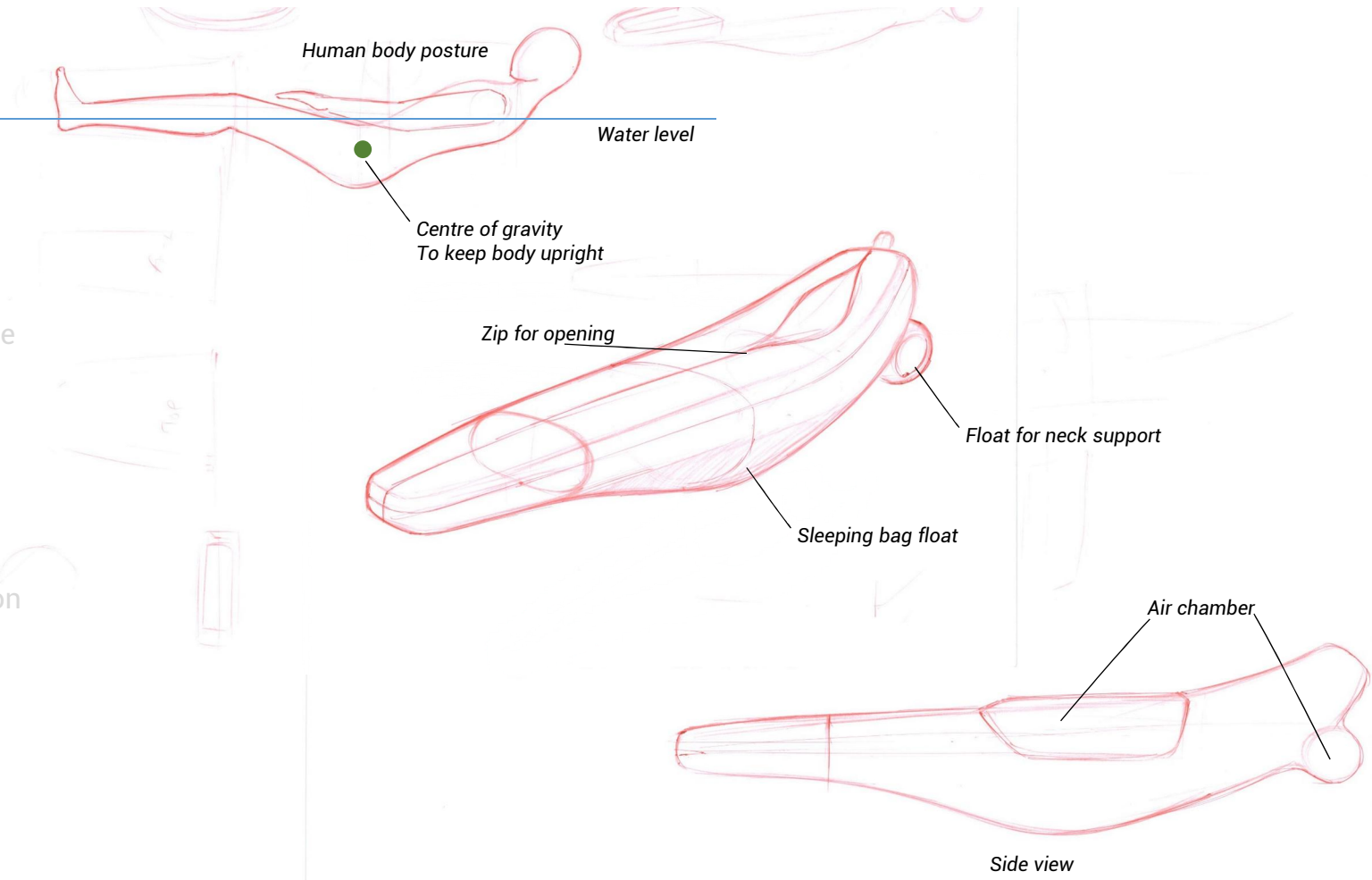
Prototype



Testing



Evaluation





Iteration - 4th



Design



Prototype



Testing

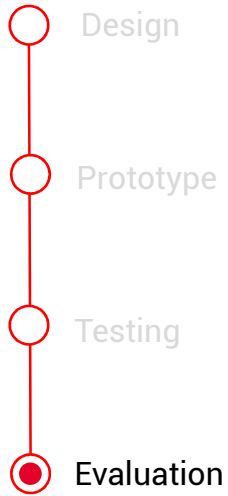


Evaluation





Iteration - 4th



Pros:
Full body protection

Cons:
Chest floats are inefficient for toppling
Difficult to ingress and egress
Legs are constrained
Balancing in upright seating posture



Iteration - 5th



Design



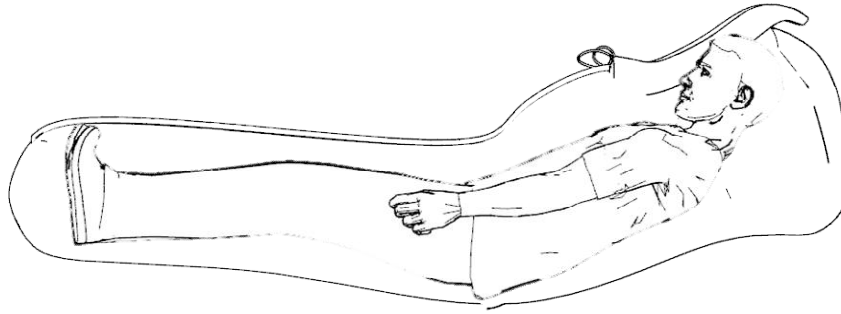
Prototype



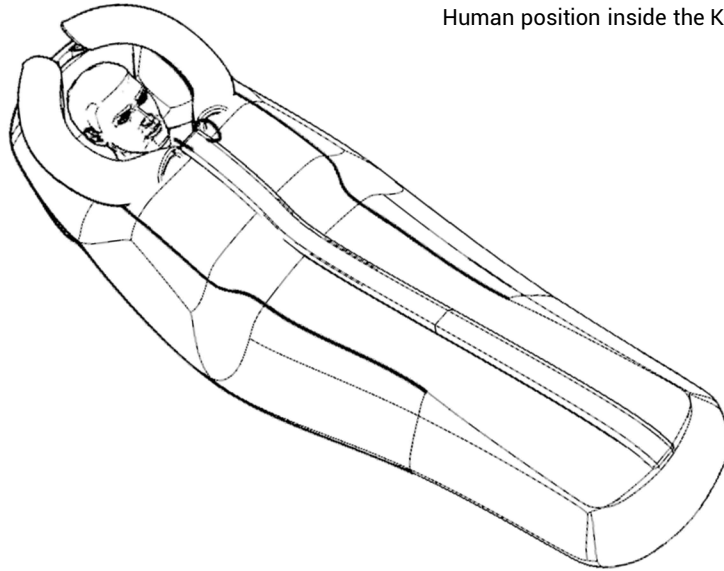
Testing



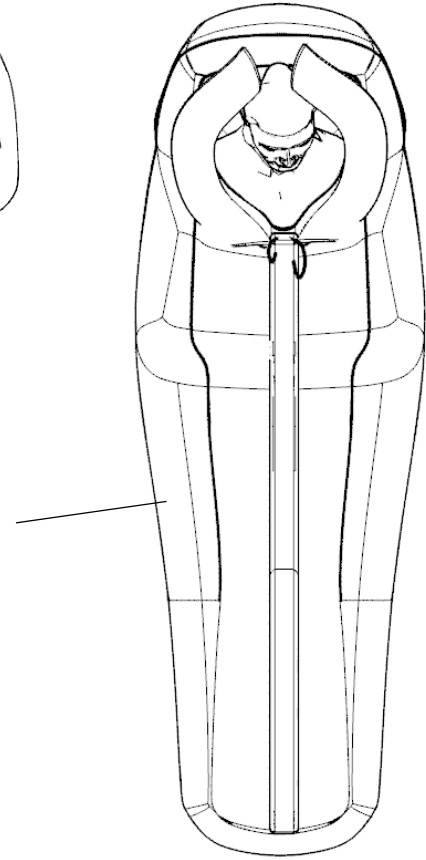
Evaluation



Human position inside the Kit



Side floats





Iteration - 5th



Design



Prototype



Testing



Evaluation

CAD Model





Iteration - 5th



Design



Prototype



Testing



Evaluation





Iteration - 5th



Design



Prototype



Testing



Evaluation



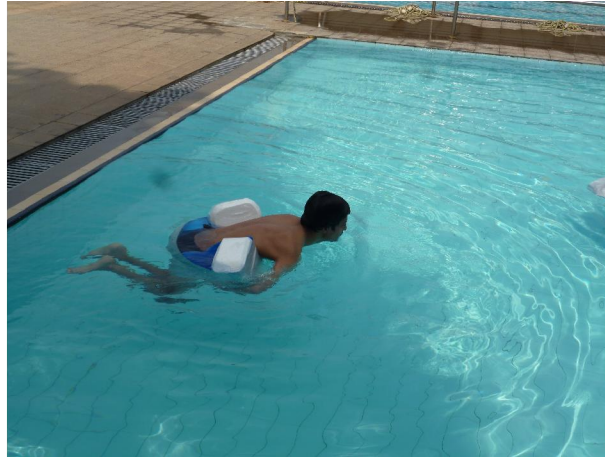


Iteration - 6th





Iteration - 6th



Exploration of possibilities of floating with buoyant material



Iteration - 6th



Exploration of possibilities of floating with buoyant material



Iteration - 6th



Exploration of possibilities of floating with buoyant material



Iteration - 6th



Exploration of possibilities of floating with buoyant material



Iteration - 6th



Exploration of possibilities of floating with buoyant material



Activity

Prototype

testing

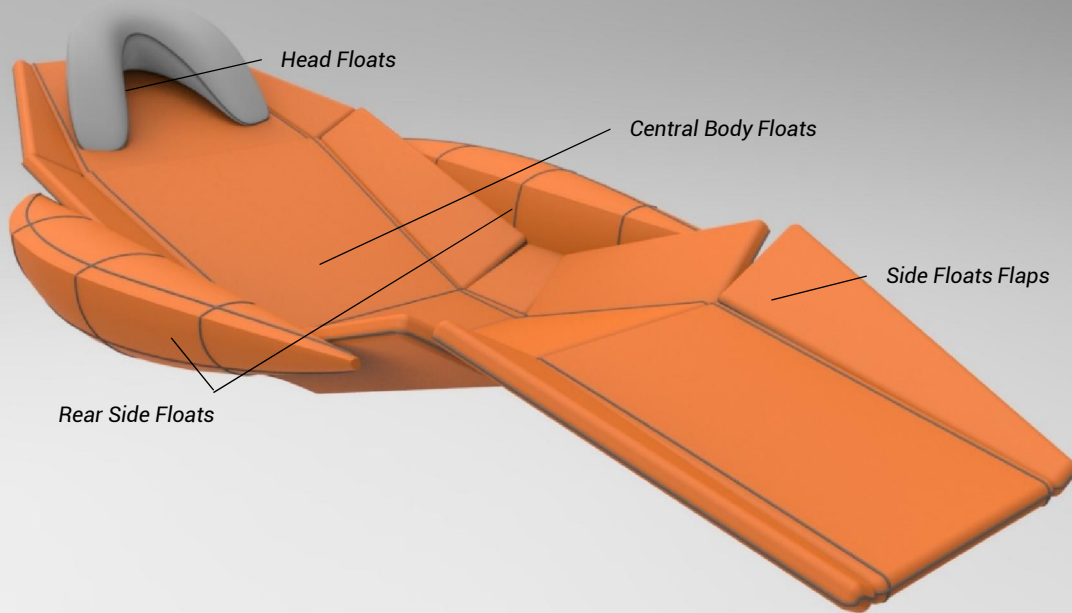
Blueprint
Illustration

Product



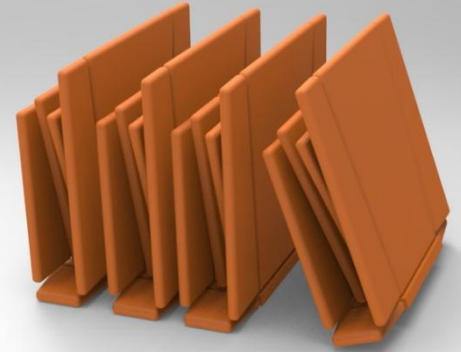


Product CAD Model



Opened Rescue Kit

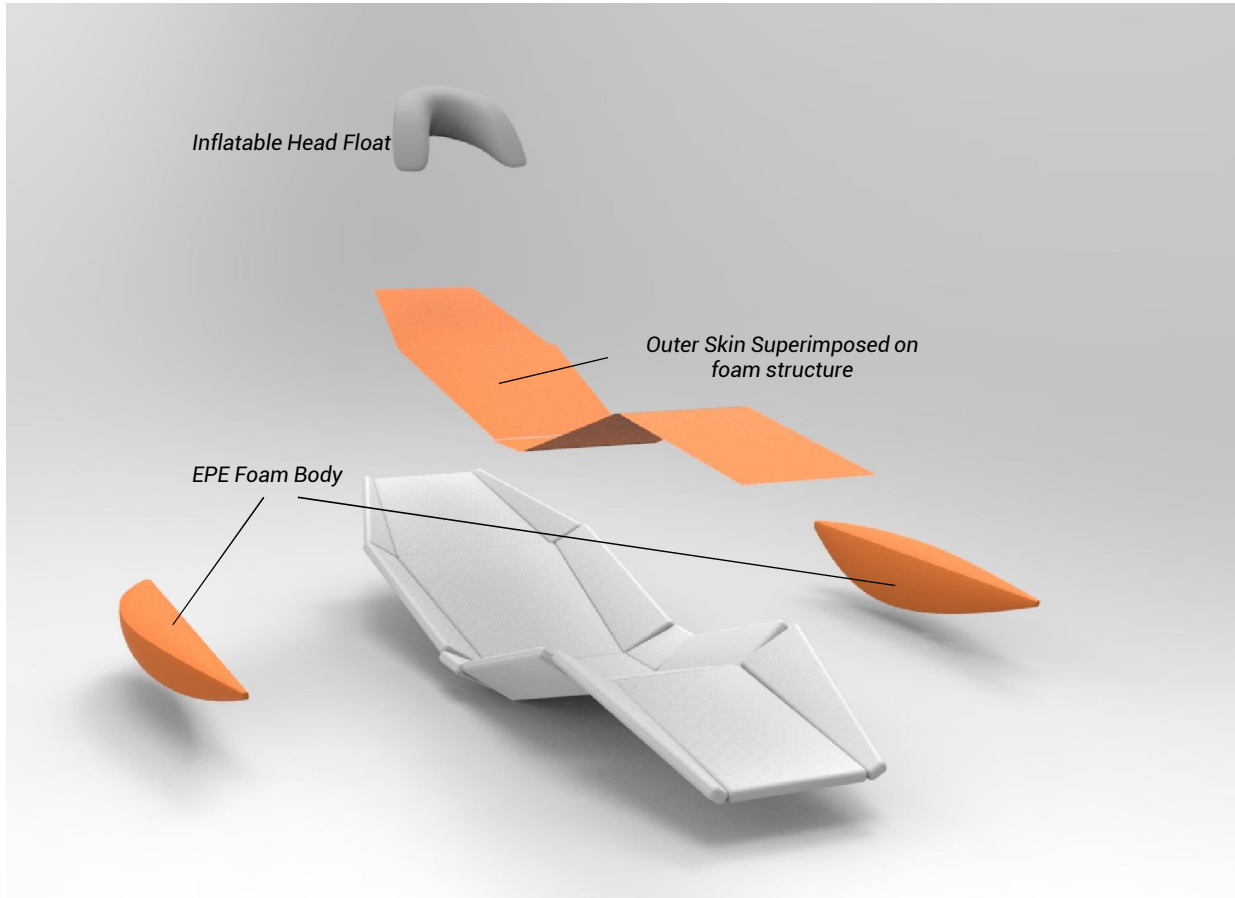
Stackability Options



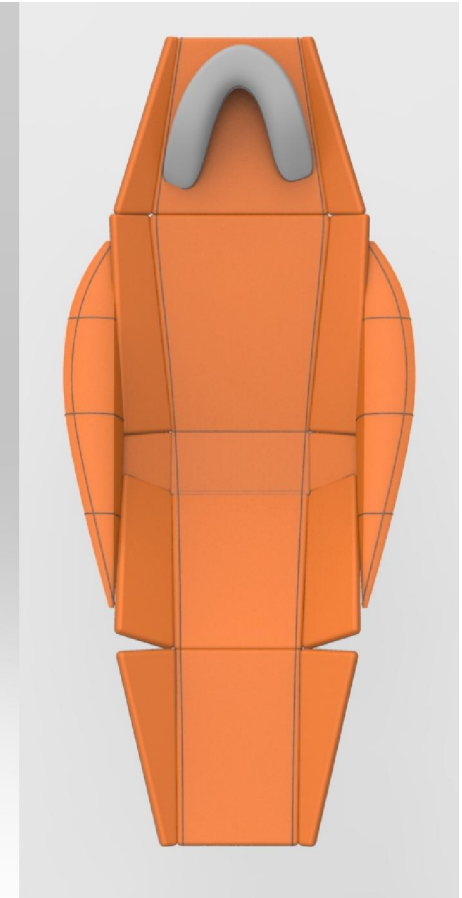
Packed Rescue Kit



Product Exploded view



Exploded View



Float Layouts



Product Prototype



Folded



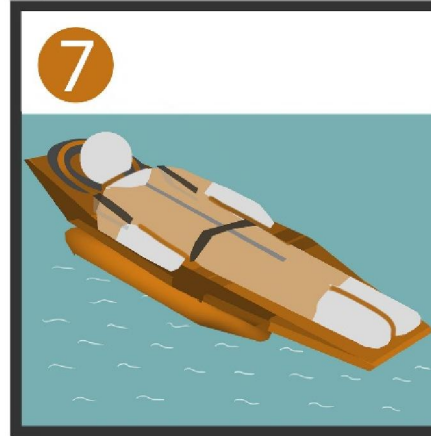
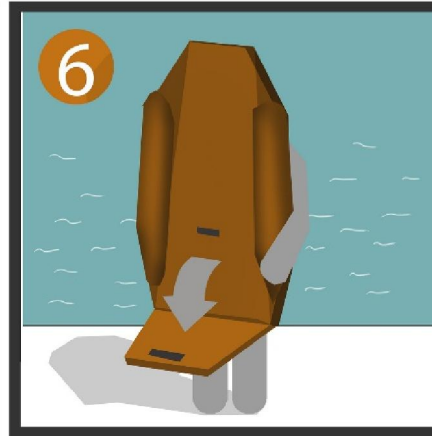
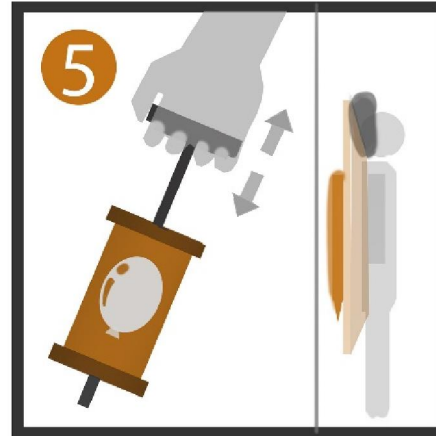
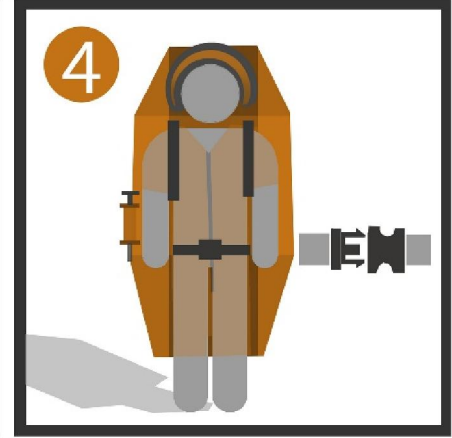
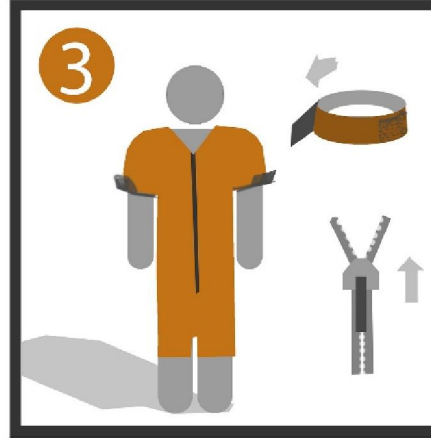
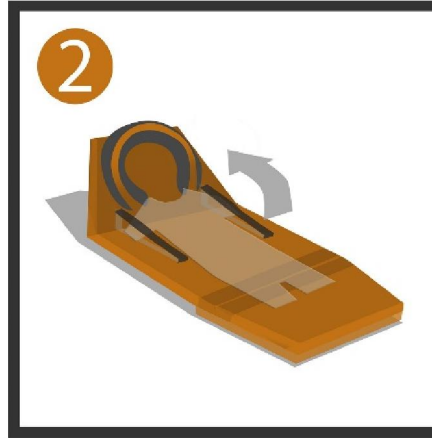
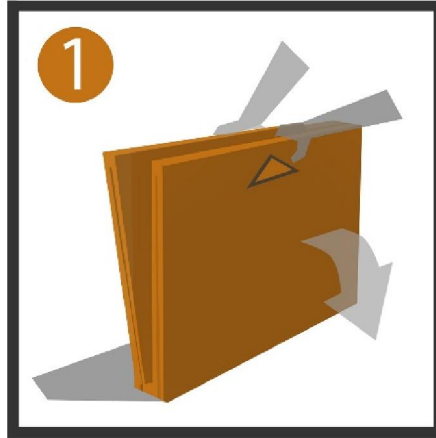
Unfolded



Usage



Product Illustrations





Product Deployment activity



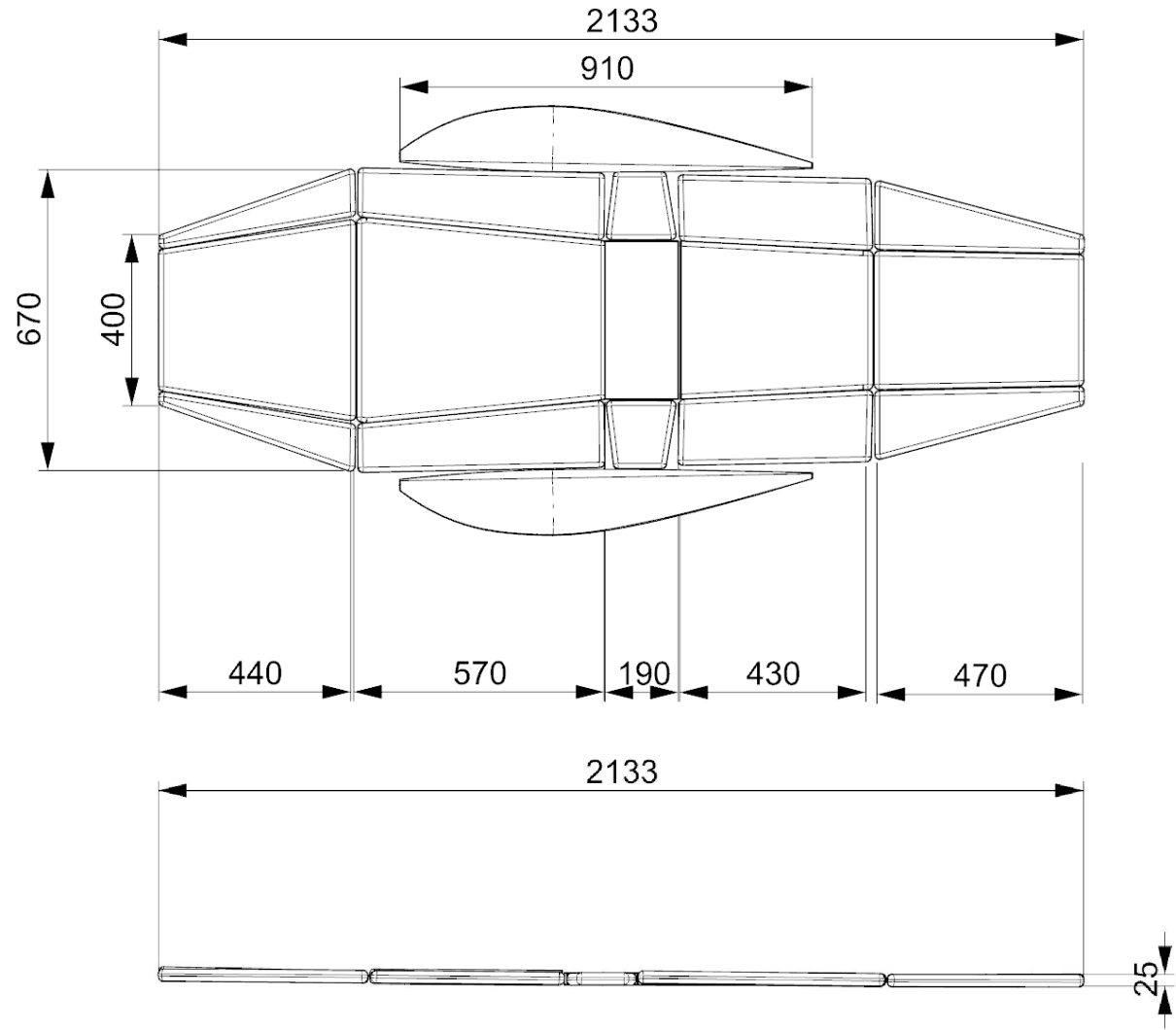


Product Testing





Product Blueprint





Product scenario



Scenario – User Deployed kit and starts floating



Product scenario



Scenario – Rescue personnel rescuing the user from the kit



Thank you